THE FOUNDRY

Established in 1892

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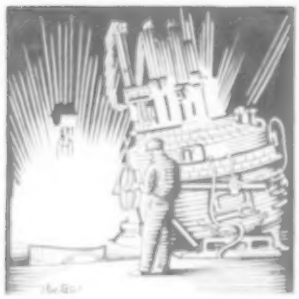

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The Silent Partner of Profitable Foundry Production . . . .

Molding Machines found amazingly adaptable to needs of modern shop practice

IN THEIR courageous efforts to keep businesses afloat and to obtain a fair living during the gradually diminishing volume of the past two years, foundrymen as well as others have been confronted with the problems of finding ways to improve production and at the same time cut their costs.

This has required a lot of careful study of products, machines and methods to discover short cuts to speed and economy without sacrificing accuracy.

Job Study Reveals Versatility

A far reaching investigation of production would bring to light the fact that among the thousands of molding machines at work, some are making molds for such tiny castings as sprinkler head fingers weighing less than a half-ounce each; some are used in casting small ball races which are even lighter; others are busy in the manufacture of fittings, valves, railroad and automobile parts of all kinds, and so on, all the way up to molding capacities in excess of 15 tons.

A Specific Case of Size

One interesting "case history" was described in an article which appeared recently in the editorial columns of a foundry journal, from which the following excerpt is quoted:

> "It is a Tabor machine of shockless type, having a rollover table 126" x 78", capable of jarring 24,000 pounds and rolling over 28,000 pounds, having a pattern draw of 30". The table is drilled with standard pin centers for flasks and patterns. In many cases patterns are fastened quickly to the table without the use of a pattern board. As many as nine pattern changes are made in a day without appreciably slowing up the production."

Realizing that these statements are from a disinterested source and apply to a large machine, any experienced foundry man will readily understand how much more fully and easily this faculty of adapting a machine to its job can be applied to smaller machines on smaller work.

In its experience covering the past forty-eight years, the Tabor Manufacturing Company has kept in step with the demands and development of the industry so that, today, the family of Tabor molding machines offers an ideal machine to meet the individual needs of any foundry.

Why not take time now to question the speed, accuracy and costs on your own work, and let us talk with you about how you can increase your output and reduce your costs with Tabor machines. No obligation involved; just address The Tabor Manufacturing Company, 6225 Tacony Street, Philadelphia, Penna.

Tabor 36" Jar Rollover Pattern Drawing Machine amid part of its day's production

THE FOUNDRY for August

Getting Set TO START

NORMALLY, the summer decline in foundry operations provides an opportunity for revamping plant and equipment. Repairs, replacement, overhaul and rearrangement serve to put the shops in shape for the usual fall pickup. Present low rate operations and the long duration of slack demand have reacted against this procedure in 1932. Many await the turn of the tide. However, a few have started and more have announced their intention of active maintenance and repair programs in August. An example is a mid-west steel foundry. Overhauling cranes, installation of additional sand conditioning and handling equipment, revamping sand blast and dust collecting units will provide work for employes of this shop. Further, it will give employment to men in the plants of equipment firms, provide orders for castings, steel and machinery plants. Multiplied many times this impetus will be effective. Self help, initiative, courage such as this will turn the tide. Get set to start.

Cut Prices BACKLASH

FOR the first time in many months, buyers are becoming skeptical of cut prices. Seconds and inferior quality products which thrive in a hard-driven buyers market are taking toll. In an attractive sales publication, David Brown & Son, British nonferrous manufacturer, quotes John Ruskin, eminent nineteenth century essayist and economist, as follows:

> "There is hardly anything in the World that some man cannot make a little worse and sell a little cheaper, and the people who consider price only are this man's lawful prey."

Such a statement of acknowledged fact is just as true today as when it was written. It applies to the purchase of needed foundry supplies, materials and equipment. Further, it is the law in the purchase of castings. Foundries that insist upon a price adequate to the quality of the castings furnished have nothing to fear in the return to buying sanity. Those that have cut their prices below manufacturing costs and have been tempted to shave and skimp are facing a new reaction.

That Last OUNCE

DEFINITE indications of improvement are at hand. Production figures, particularly in iron and steel lines have not recorded this fact. Economists, rendered cagey by past wrong guesses, are singing low. Bankers still wear a protective camouflage against long range credit firing. Nevertheless, public confidence is returning and the man-on-the-street is loosing the permanent convexity of the mouth, his Atlas shoulders and is getting the lead out of his heels. Most hopeful sign is the attitude of foundrymen out of jobs. Few of them have been regular visitors to the wailing place during these trying times. They are game and many of them mighty competent and promising assets to the next payroll on which their names will appear. Most of them have gained the athletes second wind. They are ready to expend every last ounce of energy to make that next job worthwhile to them and to their employers.

What's New IN AUGUST

HIGHLY refined cast steel, adapted for special high pressure requirements may be tied in a knot as is shown by Fred T. Hays, Akron, O. (Page 12). In pattern work, production control rarely is attempted, but is thoroughly practical and pays. (Page 14). Phosphorus is the pet deoxidizer for brass foundrymen. (Page 16). With the microscope turned on every reducible cost item, Russell C. Miller shows how a study of 7500 actual determinations gives a practical formula for rating production on squeezer molding machines. (Page 20). The Fourth International Foundry Congress is held in Paris with exceptional program, papers and entertainment features. (Page 24).

Pours Steel in Pressure Castings

Improved furnace practice and close control of every feature produce excellent product

By FRED T. HAYS

STEEL foundrymen who have had experience in the manufacture of castings designed for service under high pressure of gases or liquids and at extreme temperatures of heat and cold, realize the many and peculiar hazards incident to production of that line of castings. Variable metal thicknesses in different parts of the same casting add to the difficulty of securing a dense, clean, homogenous structure throughout.

Hydrostatic pressure will expose minor flaws and defects that would not be noticed and that would not affect adversely castings used in almost any other field. For that reason practically every pressure resisting casting offers a special study to the foundryman. A species of instinct or knowledge only gained through long experience guides him in deciding on the important factors, heading, gating, chilling and condition of the sand to insure a casting perfectly clean and solid and with desirable or necessary physical properties.

Many Factors Await Decision

In the general jobbing foundry the patterns usually are supplied by the customer. Occasionally the design and construction have been subjected to the approval of the foundryman, but in the majority of instances he is not consulted. In many cases his ingenuity is tested severely in developing a method for securing a satisfactory casting from ill designed patterns or rigging. He has to design heads and gates and see that they are placed in position to function properly on the casting. He has to decide upon the shape and application of shrink boards, plugs, hay rope, cinders, sawdust, or other devices or materials included with the sand of the mold and designed to facilitate the construction of the metal in the casting during solidification and cooling period.

Proper location of chills and vents demand attention. Moisture, strength and permeability of facing and backing sand, are factors of prime importance and should not be left to chance or to the manipulation of unskilled workmen. Core mixtures must be prepared to crush easily and thus offer a minimum amount of resistance to the contracting metal.

With all these features under control, there still remains the problem of producing a suitable metal, one that possesses the necessary physical characteristics to meet the severe tests to which it will be subjected in service.

As a result of extended experiment and research the Atlantic Foundry Co., Akron, O., has developed a metal for use in pressure castings, a plain carbon steel which it is claimed easily can hold its own on a competitive basis with forged and welded products.

Reports from customers, prominent users of

Fig. 1—Mold for a typical casting for high pressure service

steel pressure resisting castings, indicate that improved furnace practice and close control of every feature are reflected in a highly satisfactory product. On one delivery of 244 pressure castings including Ls, Ts and valve bodies ranging in size from 2½ to 12 inches, only 11 minor welds were necessary in the customer's assembling department. On another shipment of 22 large Ls and Ts, the customer reported that the castings were 98 per cent perfect. A monthly welding bill of $150.00 formerly charged against the foundry by a large buyer of pressure castings has been reduced to less than $10.00.

Steel Melted in Electric Furnace

The steel is melted in an electric furnace, made by the Pittsburgh Electric Furnace Co., Pittsburgh and operating on an acid bottom. The furnace has a rated capacity of 3000 pounds per hour, the usual amount melted is 6500 pounds. Elasticity and advantages of that type of melting medium prove very satisfactory in a jobbing shop where requirements for heats range from 1000 to 8000 pounds per heat. The average life of the roof and side walls is 600 heats. Average power consumption is 525 kilowatt hours per ton. With 8-inch graphite electrodes the average electrode cost is 80 cents per ton of metal melted.

Super refined mild, electric melted plain carbon steel made according to the method developed at the plant of the Atlantic Foundry Co., Akron, shows the following chemical analysis and physical properties:

Fig. 2—A sprue at the far right conveys metal to two gates

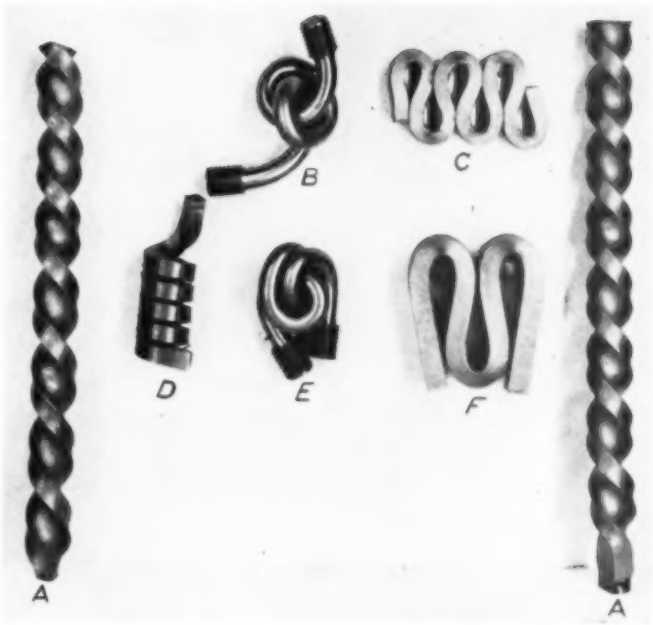


Fig. 3—Results from various tests of a steel falling in the soft range 0.22 to 0.25 per cent carbon

Carbon	0.22-0.25 per cent
Manganese	0.65-0.75 per cent
Silicon	0.40-0.45 per cent
Phosphorus	0.045 per cent, maximum
Sulphur	0.045 per cent, maximum
Ultimate tensile strength	74,000 pounds per square inch
Yield point	46,000 pounds per square inch
Elongation in 2 inches	34 per cent
Reduction in area	52 per cent

Properties of this plain low carbon steel developed at the plant of the Atlantic Foundry Co., particularly elongation, reduction in area and extraordinary bending test, may be visualized more clearly by comparing them with the properties called for in the specifications as outlined by the American Society for Testing Materials.

Gives Standard Specifications

Standard specifications for steel castings A 27-24, carbon steel for general service and for ships is divided into two classes: A, castings that are not heat treated and for which no physical requirements are specified; B, heat treated castings in which the physical requirements vary according to whether the steel falls into the hard, medium or soft grade. In class B the carbon is not specified. The phosphorus in acid practice must not exceed 0.06 per cent and in basic practice not over 0.05 per cent. The sulphur maximum is 0.06 per cent.

In the hard, medium and soft grades the minimum tensile strengths in pounds per square inch is 80,000, 70,000 and 60,000. The percentage elongation in 2 inches on the same classification is 17, 20 and 24. Reduction in area also shown in percentage is 25, 30 and 35.

The bending test specified by the A. S. T. M. on this steel on castings (*Please turn to page* 45)

Fig. 1—The patternmaker must build patterns which will meet tolerances laid down by the engineering department

Tie Patternmaking To Production

Necessary controls provided to produce high quality equipment at minimum cost

By H. M. HARROLD

Caterpillar Tractor Co.

OLD-TIMERS in the shoe business often have been quoted as saying profits are made or lost in the cutting room. It hardly would be fair to apply that statement to the pattern shop. However, the patternmaker can accomplish much in the way of economy by tying his job into the complete production picture.

There will be no attempting here, despite the opening sentence, to point out similarities in making shoes and castings. This much is true: Both industries work with nature's own materials. Cutting leather for shoe uppers is not an exact science. No two skins are alike. Much depends upon the human element. Likewise the foundryman cannot be absolutely sure of what he is going to get until the castings are shaken out of the sand.

Part of the patternmaker's job, then is to build patterns to obviate as much foundry difficulty as possible. It is his business to build

AUTHORIZATION FOR PATTERN ALTERATION

ESTIMATED COST $33.00 ORDER NUMBER GF-34 PART NUMBER LJ-232

Send Copies to Following Departments:

Foundry-1
Planning-1
Prod.-1

MAKE NECESSARY PRODUCTION PATTERN EQUIPMENT FOR PRODUCING APPROXIMATELY 1200 CASTINGS 8 PER YEAR FOR MODEL TWENTY GEAR CASE, PART NO. LJ-232.

PRODUCTION DEPT. TO ORDER TWO SAMPLE CASTINGS FOR INSPECTION DEPT.

Date 5/1/31 Signed D.F.Ogden Approved

Fig. 2 (Left)—Patterns are authorized on a special form sent from the planning department. Fig. 3 (Right)—The inspector's report is an important check against production performance

INSPECTION REPORT

PURCHASING DEPT.

Vendor OUR FOUNDRY

Part No. LJ-232 Date 5-15-31

Part Name GEAR CASE

REMARKS:

1st sample casting made from new pattern equipment - checks to blue print dated 5-14-31 showing change #2 - Checks O.K.

Proceed with production castings

Weight 41# RANDOLPH

INSPECTION DEPT

patterns which will produce castings within tolerances laid down by the engineering department, patterns which will enable the foundryman to make castings economically.

He must build patterns so that those same castings will lend themselves readily to various machine shop and assembly operations which follow along in the natural manufacturing sequence. He must keep in mind that he has an engineering and manufacturing problem all his own.

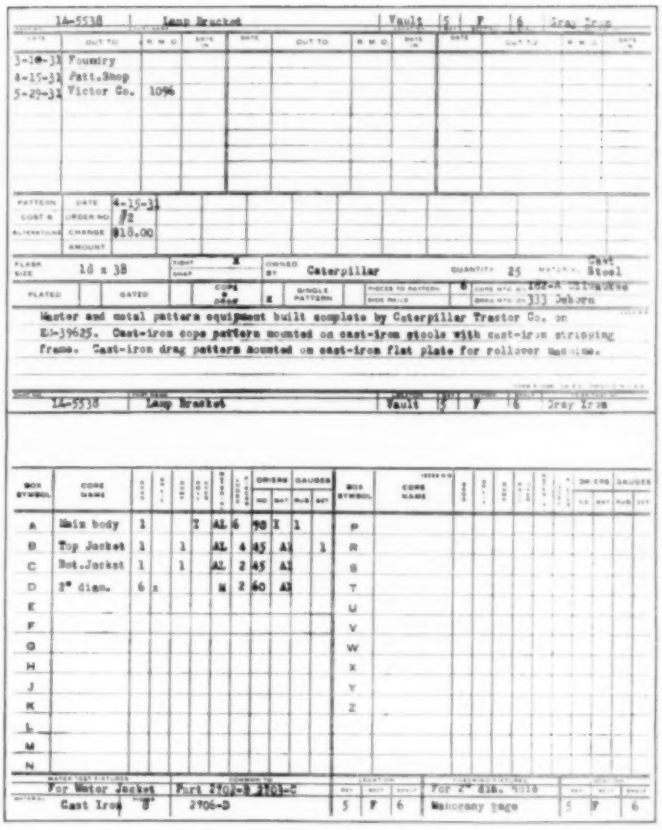
Pattern Shop Important Link

The point to be made is that the pattern shop is an important link in the manufacturing chain, and as each link in a chain completes a cycle within itself, so does the manufacturing of patterns have its starting and finishing points. Therefore, certain controls are necessary. These have been provided in the procedure followed by the Caterpillar Tractor Co., Peoria, Ill., to produce the highest quality of pattern equipment to meet production requirements at the minimum of cost.

For the moment consider what happens between the inception of an idea and its incorporation in the finished product—a tractor, for example. Someone gets the idea first. Maybe the sales department. If only such-and-such a model could develop a little more power, we could do thus-and-so.

What will it cost? How will the change best be effected? These problems are turned over at once to the research department for initial development. An experimental machine is made, tested and approved as soon as the management gives the signal, and the plans then are turned over to the engineering department.

Up to this point the chief concern has been bigger and better tractors. Now it is time to consider the actual problem of manufacture. The engineering department, in a word, acts as a buffer between research and production. It must satisfy both departments. It must aim at bigger and better tractors and get them via the most economical production route through the shop.


14-5538 Lamp Bracket Vault 5 F 6 Gray Iron

3-10-31 Foundry
4-15-31 Patt.Shop
5-25-31 Victor Co. 1096

Caterpillar 25 Cast Steel

Master and metal pattern equipment built complete by Caterpillar Tractor Co. 9-39625. Cast-iron cope pattern mounted on cast-iron pivots with cast-iron stripping frame. Cast-iron drag pattern mounted on cast-iron flat plate for rollover machine.

14-5538 Lamp Bracket Vault 5 F 6 Gray Iron

Box Symbol	Core Name	Qty	Vents	Cores	Core Prints	Orders No.	Orders Mat.	Gauges Rub.	Gauges Set	Box Symbol	Core Name	Qty	Vents	Cores	Core Prints	Dr. Cpg. No.	Dr. Cpg. Mat.	Gauges Rub.	Gauges Set
A	Main body	1		T	AL	6	90	I	1	P									
B	Top Jacket	1		1		AL	4	45	A1	1	R								
C	Bot.Jacket	1		1		AL	2	45	A1		S								
D	2" diam.	6	x			M	2	60	A1		T								
E											U								
F											V								
G											W								
H											X								
J											Y								
K											Z								
L																			
M																			
N																			

For Water Jacket — Part 2702-B 2703-C — 5 F 6 — For 2" dia. Core — Mahogany tape — 5 F 6

Cast Iron — 2706-B

Fig. 5 (Above)—Front view and Fig. 6 (Below)—Back of pattern record card

Drawings are released to the planning department. Every part is lined up as to operations and scheduled through the various manufacturing divisions. The new engine will have a new cylinder head, a new exhaust manifold, in fact almost everything new.

That means new patterns. The procedure is for the planning department to order pattern equipment and sample castings for the manufacturing division to inspect and approve before proceeding with actual casting production.

An order or pattern authorization, shown in Fig. 2, is sent from the planning department to the pattern division calling for certain new patterns or for changes to (*Please turn to page* 46)

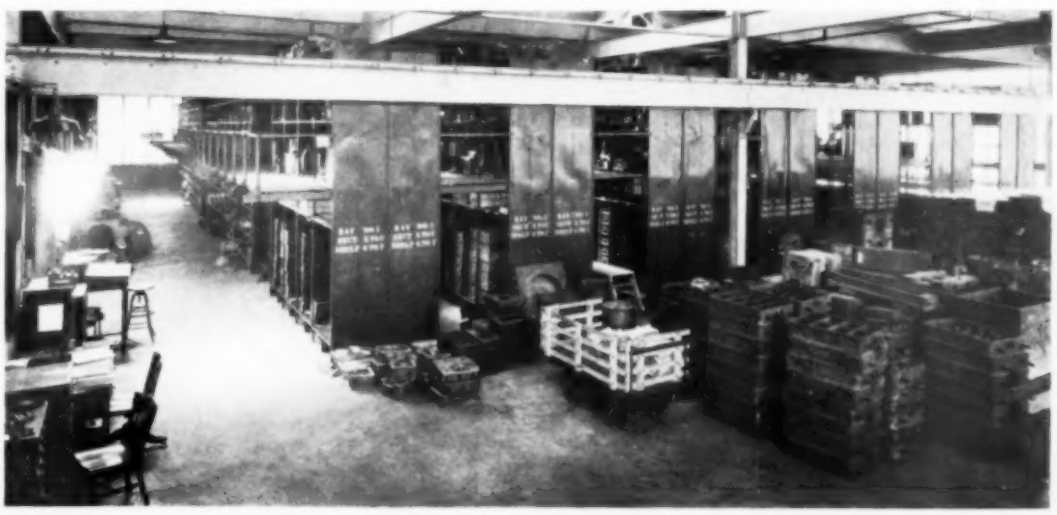


Fig. 4—It is important to keep patterns in good condition and readily accessible

Fig. 1—Castings were poured, cleaned, ground and tested in an exceptionally short time

Phosphorus in Red Brass

Serves as deoxidizer in addition to making the metal fluid and protecting the stream

By R. W. PARSONS
Ohio Brass Co., Mansfield, O.

ONE question submitted at the nonferrous round table discussion of the A. F. A. held in Chicago in May, 1931, was on the effect of phosphorus on brass and bronze, with special reference to slight traces of 0.01 to 0.02 per cent. As it seems to the author that those amounts of residual phosphorus would be considerable in semired brass alloys of modified 85-5-5-5 variety having zinc in excess of 5 per cent, it was felt that a report of such aspects of this question as have come under his observation might be of interest.

The alloy which the author has in mind has the nominal composition of 81.5 per cent copper, 3 per cent tin, 7 per cent lead and 8.5 per cent zinc. Thus, it would fall within the classification, as made by Thews of those alloys which contain sufficient zinc so as not to require deoxidation in the molten bath but which require small quantities of phosphorus which act to prevent oxidation during the period of pouring.

Phosphorus is used rather widely in foundry practice in the form of a phosphor-copper shot containing 10 to 15 per cent phosphorus, and in this article the term *phosphorus* often is applied rather loosely to the phosphor-copper alloy as well as to the element.

Phosphorus is referred to freely in the literature as a deoxidizer for brass and bronze, and in such sections as the Question and Answer department of THE FOUNDRY and elsewhere 1.5 ounces (0.1 per cent) of phosphor-copper per 100 pounds of metal frequently is recommended for red brass. Sometimes limits of 0.1 to 0.2 per cent are given, and occasionally considerably more is not considered detrimental.

Small Amount Is Retained

In the case of 0.1 to 0.2 per cent, which have been given as limits for 10 per cent phosphor copper, this would mean adding 0.01 to 0.02 per cent phosphorus, of which considerable would be lost, so that the amount retained would be a few thousandths of 1 per cent. In bronzes, free from zinc or nearly so, amount of phos-

phorus used often is several hundredths of one per cent.

Before relating results of practical tests made in this connection, it might be profitable to speculate on the manner phosphorus functions. A convenient measure of ability of an elementary metal to deoxidize may be had from a consideration of the heat of formation of the resultant oxide. These values may be found in any of several handbooks, and texts and compilations such as Table I from the *Handbook of Chemistry and Physics*, have appeared previously in foundry literature. The listed data on affinity, applying as they do to room temperatures, do not necessarily hold at the temperatures of the red brass melt, nor does it follow that the order of elements as given will be the same at elevated temperatures.

Table I indicates that tin has a greater affinity for oxygen than has copper and, therefore, should deoxidize copper as it generally is accepted that it does. However, it will be noted, that the resultant oxide has a high gravity as compared to the others listed, and we should not expect it to free itself from the red brass melt (which has a gravity in excess of 8.0) as readily as a lighter oxide, such as that of zinc.

Aids in Eliminating Oxide

This is one reason for the marked improvement in casting properties brought about by additions of zinc to the tin bronzes, as in the case of Navy G bronze. Since tin oxide is known to be hard and is likely to dull tools during machining, considerable phosphorus usually is added to deoxidize tin bronzes and aid in the elimination of the objectionable oxide.

Aluminum and silicon, although ranking high as regards their affinity for oxygen, are not to be considered for red brass in view of their unfortunate reactions with the lead. Magnesium probably is not a desirable impurity in red brass. Metallic boron, if it were available, would seem a logical choice for investigation and study.

Zinc and phosphorus have considerable affinity for oxygen and are good deoxidizers for red brass, with the former a trifle superior. Of those listed, only these two elements have boiling points below the temperature of the red brass melt (phosphorus, 550 degrees Fahr.; zinc, 1688 degrees Fahr.). The oxidation products are sufficiently light so that they should be able to free themselves from the melt without great difficulty. It will be noted that the oxide of phosphorus is extremely light (second only to boron), and in addition it sublimes instead of melting. Apparently the deoxidizing action of zinc, which is added in such relatively large quantities, should leave the melt (to all practical purposes) free from oxides, insofar as phosphorus additions are concerned and in view of the small amounts of the latter used. Why is it, then, that phosphorus is used to deoxidize red brass?

Table II presents the matter in a little different light in that capacity of various elements for oxygen is shown. Here, other things being equal, the lighter the element, the greater its capacity. Phosphorus is second only to boron and considerably ahead of zinc.

Even if the phosphorus trioxide, P_2O_3, is considered, the value still would be 0.773, which would not alter its position from a practical standpoint since silicon and aluminum are eliminated automatically as possibilities. Even though capacity of phosphorus for oxygen is five times that of zinc, the ratio of phosphorus to zinc used in the foundry is much less than 1 to 5, so that the question is still not answered.

Action of phosphorus certainly is debatable, although reference to some of the available theories and information may suffice to shed some light on the subject. Clearly, copper oxide should not exist in the presence of tin, nor should tin oxide be (*Please turn to page* 48)

Table II

Capacity of Elements for Oxygen

In forming the oxides given in Table I:

1 oz. of Boron	takes up 2.18	oz. of Oxygen
1 oz. of Phosphorus	takes up 1.29	oz. of Oxygen
1 oz. of Silicon	takes up 1.13	oz. of Oxygen
1 oz. of Aluminum	takes up 0.886	oz. of Oxygen
1 oz. of Titanium	takes up 0.665	oz. of Oxygen
1 oz. of Magnesium	takes up 0.658	oz. of Oxygen
1 oz. of Calcium	takes up 0.400	oz. of Oxygen
1 oz. of Manganese	takes up 0.291	oz. of Oxygen
1 oz. of Iron	takes up 0.287	oz. of Oxygen
1 oz. of Nickel	takes up 0.273	oz. of Oxygen
1 oz. of Tin	takes up 0.270	oz. of Oxygen
1 oz. of Zinc	takes up 0.245	oz. of Oxygen
1 oz. of Copper	takes up 0.126	oz. of Oxygen

Table I

Ability of Elementary Metals To Deoxidize

		Heat of Formation of Oxide		Properties of Oxide	
Element	Oxide	Calories per Gram Molecule	Calories per Gram Atom of Oxygen	Melting Point, degs. Fahr.	Specific Gravity
Calcium	CaO	151.9	151.9	4600	3.3
Magnesium	MgO	143.9	143.9	5000	3.4
Aluminum	Al_2O_3	392.6	130.8	3700	3.9
Titanium	TiO_2	218.4	109.2	2800	4.2
Silicon	SiO_2	191	95.5	3100	2.2
Boron	B_2O_3	272.6	90.8	1070	1.8
Manganese	MnO	90.8	90.8	3000	5.1
Zinc	ZnO	84.8	84.8	3300	5.4
Phosphorus	P_2O_5	365.2	73.0	Sublimes	2.4
Tin	SnO_2	137.2	68.6	2050	6.9
Iron	FeO	65.7	65.7	2600	6.9?
Nickel	NiO	57.9	57.9	†	6.7
Copper	Cu_2O	43.8	43.8	2100	5.9

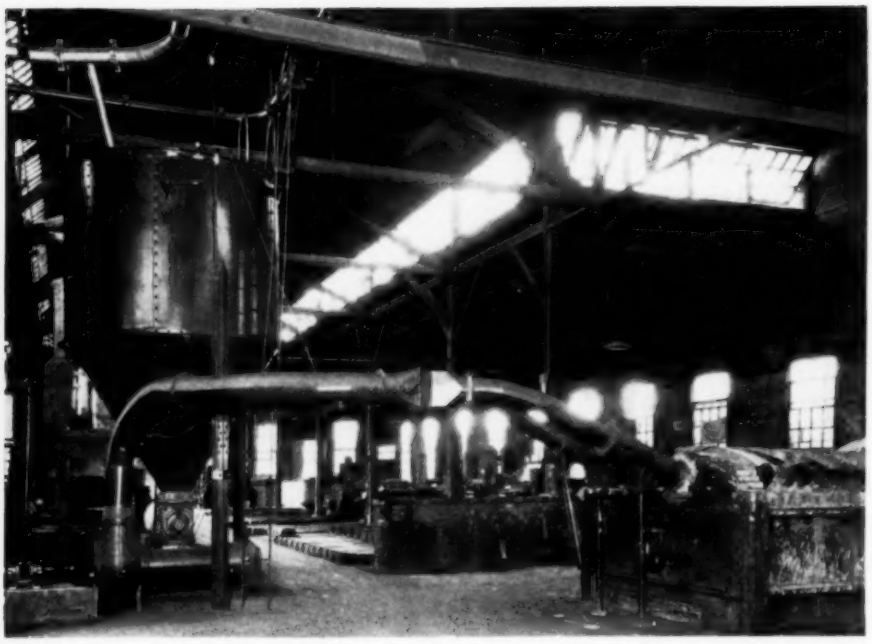


Fig. 1—Air furnace of 15-ton capacity is fired with powdered coal

Fire Furnaces with Powdered Coal

Cleanliness of plant and economy of operation are features of installation in malleable shop

BY FRANK S. O'NEIL

Link Belt Co., Indianapolis

ENGINEERED to fit peculiar foundry requirements for production of malleable iron and promal iron, a modern installation of pulverized coal equipment for melting furnaces, annealing ovens and boilers is in operation at the Ewart works of the Link-Belt Co., Indianapolis. That malleable foundry has been in use some 17 years, all equipment hitherto being hand fired. Products have been high quality chain castings and industrial castings, produced in accordance with latest practice.

Coal Handled Automatically

Cleanliness and orderliness of the plant are impressive. From receipt at the plant until it enters the furnace, coal is handled automatically, the entire system being absolutely dust-tight. Fig. 5 shows the general arrangement of various units and equipment. The fact that all furnaces, ovens and boilers were already in use, most of them for a considerable period of time, illustrates the ease of applying pulverized coal to old equipment. Few changes were required and the entire system was put in without interrupting plant schedules.

The system consists of crushing and pulverizing equipment, conveying lines, storage hoppers and feeding and firing units for different furnaces. Capacity of the preparation plant is sufficient to permit adding more ovens or furnaces as production increases. Design will permit future additions without disturbing the main system or losing any part of present equipment.

Follows Path Through System

Tracing the path of coal through the system, an incoming car is spotted over a receiving hopper underneath the switch track and coal is dropped into that hopper. From there an inclined steel apron conveyor carries it to a double-roll crusher in the preparation building alongside the track. The crusher has a capacity of 36 tons per hour. The apron conveyor is equipped with a magnetic head pulley to take out the tramp iron before coal enters the crusher. The crushed coal, reduced to $1\frac{1}{4}$-inch

lumps, drops into a bucket elevator, which carries it to the concrete storage silo of 700-ton capacity, shown in Fig. 4.

From the silo the coal is fed by a gravity chute into the pulverizer or kiln roller mill, where it is pulverized and dried at the same time. Air for drying coal in the pulverizer is heated in a separate oil-fired heater, and enters the pulverizer at a temperature of 300 degrees Fahr. This gives a temperature of from 110 to 150 degrees Fahr in the pulverized coal discharge pipe.

Controls Degree of Fineness

Automatic control is provided so that the heater is shut off when air reaches the desired maximum temperature. This can be regulated to suit conditions. Excess air used for drying passes through a cyclone collector at the top of the pulverizer and is discharged outside the building. The degree of fineness is under rigid control and due to using air separation the desired fineness is maintained easily. Dry pulverized coal is discharged into a 60-ton capacity storage hopper and is ready for distribution to the various furnaces and ovens.

Distribution is made by a pneumatic conveying system controlled from a central signal board at the main storage hopper. Coal is conveyed through 4-inch pipe direct to various units to be fired. Before dispatching to the furnaces the coal is fed into a 5-ton weighing tank mounted on a scale with weightograph attachment, which accurately records the amount of fuel

A dust collecting line is installed, parallel to the conveying line, which removes the fine coal dust carried off by the cyclone collector located at one of the furnaces.

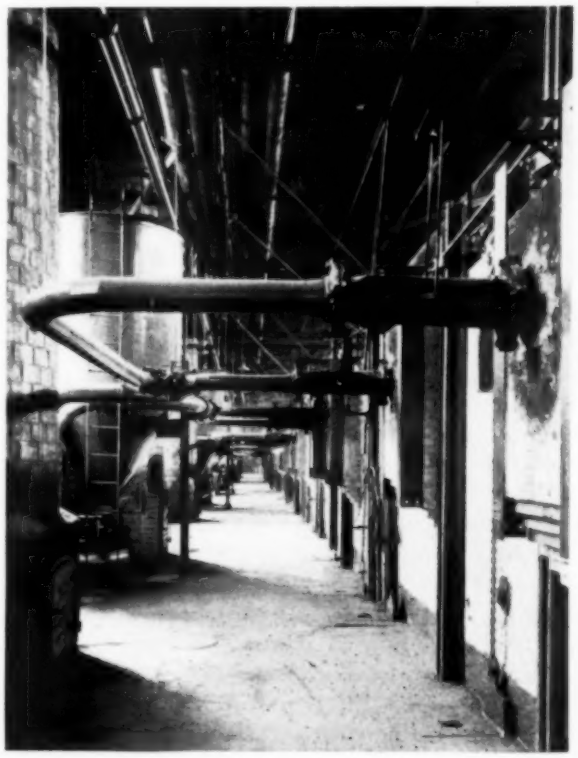


Fig. 2—Battery of 18 malleable iron annealing ovens showing main lines for transporting the coal

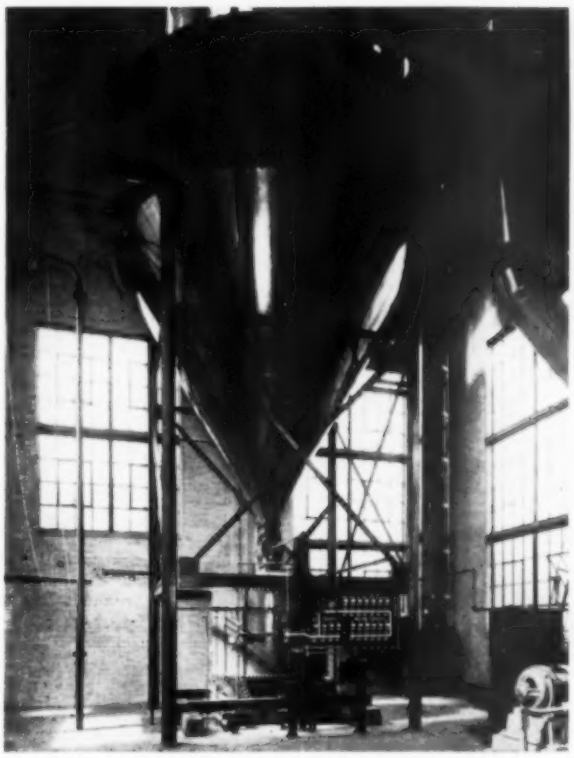


Fig. 3—Corner of the pulverizing plant showing the storage tank and the signal board

To illustrate the automatic operation of this system, let it be assumed that coal is needed for a given furnace. The furnace attendant actuates a pushbutton and immediately a colored light appears on the central signal board, telling the operator that coal is desired at the furnace in question. The operator then presses a button which releases the switching valve at the furnace and allows the furnace attendant to open the valve by pulling the pendant chain. Automatically a different colored light flashes on the central control board, informing the operator that the valve at the furnace is open.

Supply Furnace with Coal

Coal is conveyed by compressed air under 15 to 35 pounds pressure and as soon as it reaches a predetermined level in the storage bin at the furnace, an automatic limiting device closes the valve and stops the coal flow. At the same time a third light flashes on at the central control board to signal the operator that the furnace has been supplied.

The system is so interlocked that switching valves for drawing coal from the main line cannot be opened by the pendant chain until the operator at the central control board has released the valve. The safety manhole cover on each individual storage hopper also is interlocked so that no coal can be conveyed into the hopper if the manhole cover is not sealed properly. Cost of transporting coal by compressed air averages about (*Please turn to page* 50)

Rating Squeezer Production

Formula has factors for finding different elements of work and degree of influence

By RUSSELL C. MILLER

Osborn Mfg. Co.

AFTER a long period of excellent progress in scientific control of foundry materials and methods, and the more recent definite efforts to gain better control of the costs, it is not surprising to see the searchlight of economy focusing sharply on control of direct molding costs, particularly on machine production. Direct molding cost usually occupies a key position in the cost structure. While it is true that blanket figures based on that cost frequently are revised for safe average operation, inaccuracy in that basic element causes a considerably expanded fluctuation in the sale price or casting cost of individual castings.

Inaccurate selling prices traceable to poor control of molding rates (direct molding costs) cause real dollar losses to jobbing foundries, because they are out of line with competition on the high prices, and take too little profit on the low prices. In departmental foundries distorted casting costs create cost errors throughout the plant, with a similar effect on the finished product.

Results of Molding Rate Control

Material advantages of better molding rate control are numerous and more or less obvious. Money would be saved by the psychological effect of knowledge by all concerned that the management has definite control of this matter, eliminating the present tug-of-war between the molder and management, and thus permitting closer rating of work. It would lessen the fear of a good producer of injuring the scale, leaving him free to produce his maximum. It would help to classify molders for the profitable elimination of laggers. A clearer insight into the basic elements effecting these rates would equip the foundry executive better to devise changes in practice, and predetermine the economy of such moves. Definite dependable data in this field would enhance greatly the work of trade associations.

There are a number of methods in use for determining this molding rate, many of which have considerable merit. While foundry management has reached the point where it is really a branch of mechanical engineering, there are still operations in foundry practice which vary from those of allied manufacturing to such an extent that rate control methods, proven satisfactory in other branches, always can not be applied in the casting shop One of the principal differing factors is the machine molding operation. Truly this is a high production process with the aid of machinery, but production of each mold or unit requires the performance of a long list of operations which are of a widely different class or character; some operations requiring speed only, others skill, and others hard labor.

Three Classes of Operations

Extensive study of molding machine production indicates that operations required to make a mold on any machine, or group of machines, fall into three groups. The first group consists of those operations which, on any given type of machine, practically are standard to any job, and to which as a group a standard time can be allotted. The second group consists of operations which vary with the flask dimensions and pouring weight. Operations in that group are elements of hard labor, and can be controlled properly only on the basis of physical effort required. Figured along purely mechanical lines of foot-pounds per dollar, minute, or point, a correct relative value for that part of the work can be found for the varying conditions. The third group consists of special or extra operations such as setting cores, bands, chills, nails, extra riddling, etc. By classifying cores and listing other special operations an accurate control of these values may be maintained.

Types of machines and methods of application vary to such an extent at present that base rates for all types of production seem impractical. However, it is not too difficult, and would seem beneficial, for any foundryman to formulate, along these lines, each different type of producing unit in his foundry, or one which he has studied in another plant, to establish a cor-

rect relative value for any work to be run on any particular unit. In setting the standard value for Group 1, care must be exercised to make sure that time is taken for performing these operations only at a best practical speed with little fatigue, as much of the fatigue of Group 2 operations, which varies with the job, is distributed through Group 1 operations.

Squeezer molding is a comparatively simple, one-man process very generally used, which follows a practically standard procedure throughout the country. Therefore it has been possible to develop a simple formula which may be applied for determining relative base values (piece rate, man-minutes, or points) for that class of work. By base values is meant values which, as obtained by the formula, are correct in their relation to each other, but for universal application they must be adjusted on a percentage basis to suit various local conditions. This percentage factor is easy to determine, and its use as standard procedure does not alter the relations established by the formula.

Find Different Elements of Work

The basic formula necessarily consists of a number of factors for finding the different elements of work and their degree of effect It is not necessary to describe this data in detail, but it should be pointed out the data have been worked out carefully on the basis of observations of that type of work in foundries from Maine to Texas. In outline the formula was derived as follows, using the skeleton designations:

A—Time for group one, established by study as base.
B—Time for group three, to be estimated or determined as required.
E—Work filling flask
F—Work rolling over
G—Work lifting and closing cope
H—Work setting out
J—Work pouring

Table I

Simplified Formula For Squeezer Machine Molding

FORMULA: 1.42+CX+DY+.053K+1.42B

Flask width inches	X	Y
8	0.00142	0.00128
9	0.00146	0.00131
10	0.00149	0.00134
11	0.00153	0.00137
12	0.00157	0.00140
13	0.00161	0.00143
14	0.00164	0.00146
15	0.00168	0.00149
16	0.00172	0.00152
17	0.00175	0.00155
18	0.00179	0.00158
19	0.00183	0.00161
20	0.00187	0.00164

Example: Job 10x20, 5 inch cope, 5 inch drag, pouring weight 10 pounds, Group 3 time 0.10 minutes

Group 1	1.42
CX (1000x.00149)	1.49
DY (1000x.00134)	1.34
0.053K (.053x10)	.53
1.42B (1.42x.10)	.14
TOTAL or BASE RATE	4.92

Some Group 3 Values (1.42B)

Class *A* = 0.015 (1 sec.)
B = 0.03 (2 sec.)
C = 0.06 (4 sec.)
D = 0.12 (8 sec.)
E = 0.24 (16 sec.)

Cores, chills, nails, soldiers and chaplets—0.10 (4.2 seconds) plus classified setting value. (see text).
Bands = 0.10
Additional sprue = 0.13
For vibrator frame pattern, add 15 per cent
For gated pattern, add 20 per cent
Other Group 3 values are found by 1.42 times actual or estimated time in minutes (or .015 x time is seconds).
All of these values are relative to the other values in the formula, so must be added before the percentage adjustment is made.

L—Value of unit of work, established by study as base.
V—Value for unit of time, established by study as base.

Following skeleton formula was developed:

$$VA + L(E + F + G + H + J) + VB = \text{Rate}$$

Breaking this up and substituting, the following working formula was found:

$$1.42 + .00045C(W + 2.48) + .00037D(W + 2.82) + .053K + 1.42B = \text{Rate in dollars per hundred.}$$

In this formula designations are as follows:

(*Please turn to page* 58)

Table II

Schedule of Base Rates To Facilitate Checking in Practical Use

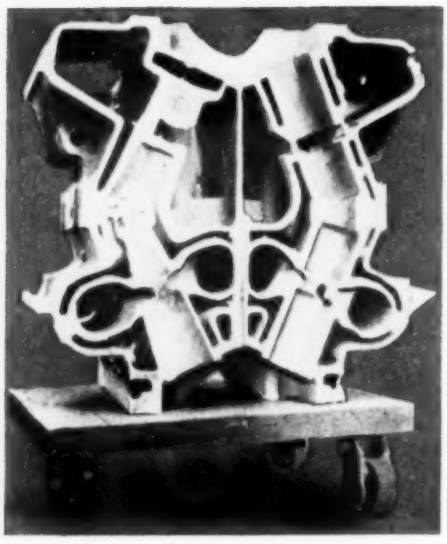
Depths		2	2½	3	3½	4	4½	5	5½	6	6½	7	7½	8	9	10		
12x23	C	1.58	1.79	2.01	2.23	2.44	2.66	2.87	3.09	3.31	3.52	3.74	3.96	4.17	4.61	5.04	C	12x23
	D	1.48	1.67	1.87	2.06	2.25	2.45	2.64	2.83	3.03	3.22	3.41	3.60	3.80	4.18	4.57	D	
12x24	C	1.61	1.84	2.07	2.29	2.52	2.74	2.97	3.20	3.42	3.65	3.87	4.10	4.33	4.78	5.23	C	12x24
	D	1.52	1.72	1.92	2.12	2.32	2.52	2.72	2.92	3.13	3.33	3.53	3.73	3.93	4.34	4.74	D	

Pour. Weight	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Value	0.05	0.11	0.16	0.21	0.26	0.32	0.37	0.42	0.48	0.53	0.58	0.64	0.69	0.74	0.79
Pour. Weight	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Value	0.85	0.90	0.95	1.01	1.06	1.11	1.17	1.22	1.27	1.32	1.38	1.43	1.48	1.54	1.59
Pour. Weight	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Value	1.64	1.70	1.75	1.80	1.85	1.91	1.96	2.01	2.07	2.12	2.17	2.23	2.28	2.33	2.38

Example of use on Floor No. 15
Pattern Number—B-600 Size Flask—12x24 inches

Cope Depth	4	Value 2.52
Drag Depth	3½	Value 2.12
Pouring Weight	10	Value 0.53
Group 3 time*	0.07	Value 0.10
Total Base Value		5.27
Adjusted Value or Rate		5.80

*Value for Group 3 is found by multiplying estimated or actual time by 1.42 (see formula), or is taken directly from classified list of values.



Aluminum Castings Used In New Diesel Engine

Fig. 1—Sectional view of the cylinder block casting indicating location of various parts

AFTER 12 years spent in experimental construction, of building up and tearing down, F. B. Stearns, veteran automobile maker, Cleveland, recently completed an engine which bids fair to assume an important place in aviation, automotive, railroad, marine and other fields. The new engine is extremely compact and is constructed altogether of aluminum alloys, with the exception of the nickel iron cylinder sleeves, chrome nickel crankshafts and fuel crankshafts, connecting rods and nitrided steel plungers and bushings of the fuel pump.

Vibration practically is eliminated in this new two-stroke diesel type engine where the eight cylinders are arranged diamond fashion with 16 opposed pistons as shown in full cross section in Fig. 2. The upper and lower crankshafts are connected by a train of double helical gearing at the rear end of the engine.

Made in Several Sizes

Several sizes of this engine are in contemplation. The example, recently completed and shown in the accompanying illustrations, weighs 2000 pounds and develops 175 horsepower at 1500 revolutions per minute. Controllable speeds range from 200 to 1500 revolutions per minute. Cylinders are bored to $3\frac{1}{4}$ inches and the piston stroke is 5 inches, a total piston travel of 10 inches for each charge. Operating on fuel oil it is claimed that the consumption is 0.4 pounds per horsepower hour. Air for scavenging the cylinders at a pressure of 4 pounds per square inch is supplied by a positive pressure type blower shown at the rear of the engine in Fig. 3, and made by the Roots-Connersville-Wilbraham Co., Connersville, Ind.

The space between the two sections in each cylinder is the combustion head where the charge of air is compressed and into which the charge of fuel is sprayed immediately before combustion occurs. In the sectional view of the cylinder block Fig. 1, the four openings near the bottom belong to the exhaust manifold surrounded by a water jacket which also embraces the cylinders. The large chambers near the top are air chambers into which air is driven by the blower and taken into the cylinders as required.

Instead of using valves, each cylinder operates through a port in four sections. The upper ports are connected to the air chamber and the lower ports exhaust into the manifold near the bottom. A heavy central rib where the half blocks are joined is designed to strengthen the cylinder block. Spray injection nozzles and their operating crankshafts occupy the space within the recesses on either side between the air chamber above and the exhaust manifold below. The space is enclosed or covered by a plate attached by screw clamps to the frame and easily removable.

Following the explosion, the two pistons in each cylinder are forced in opposite directions until the ports are uncovered. When the upper port is cleared, air from the chamber alongside at 2 to 4 pounds pressure, is forced spiraly into the upper cylinder where it drives the explosion gas before it through the lower port uncovered simultaneously with the upper.

Leave Clean Charge of Air

By the time the ports are covered again by the returning pistons, these gases have been forced out, leaving a clean charge of air trapped in the space between the pistons at a pressure apreciably above atmospheric pressure before compression commences. This air is compressed in the head space. At a predetermined point before top center the fuel charge is forced into this space in a fine spray under a pressure of 9000 pounds per square inch. The fine, fan shaped spray atomizes the oil to an extreme degree. Combustion results from the heat of compression.

One of the principal advantages of the upper and lower crankshafts is that uniflow of air is ef-

fected through the cylinders in scavenging. As the upper and lower pistons recede on the firing stroke, the four exhaust ports at the bottom of the cylinder are uncovered, and subsequently the four inlet ports at the top. Obviously the inlet ports are open after the exhaust ports close. As air flows in under pressure, an excess is provided which results in supercharging.

Control Speed of Engine

Special fuel nozzles of the needle valve type are utilized. A 3-cylinder plunger pump maintains constant pressure at each nozzle. Nozzles are operated positively by tapered sliding cam tappet. An ingenious method is employed for controlling the speed of the engine, providing instant response and flexibility within the speed range. Sliding fuel cam shafts are mounted at each side of the engine. They are connected through suitable links and the shaft at the left is equipped with a control handle shown at *A* in Fig. 3. The fuel opening is increased or decreased by sliding the shaft toward the back or front of the engine.

Castings for the engine were made at the Cleveland foundry of the United States Aluminum Co. In the original design, the cylinder

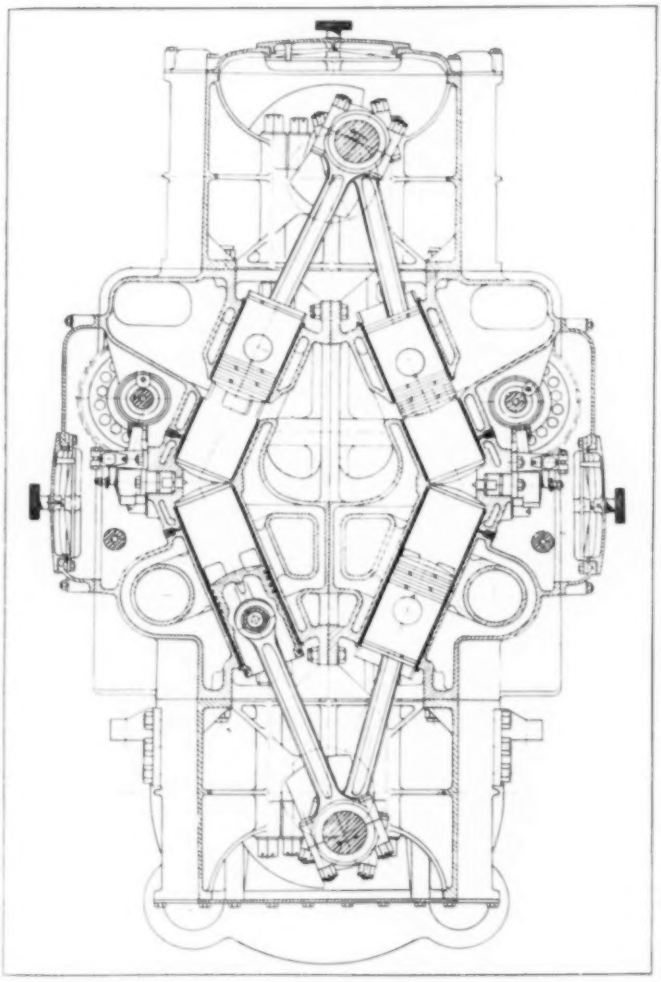


Fig. 2—Cylinders are arranged in the form of a diamond, as shown in this sectional drawing of the engine

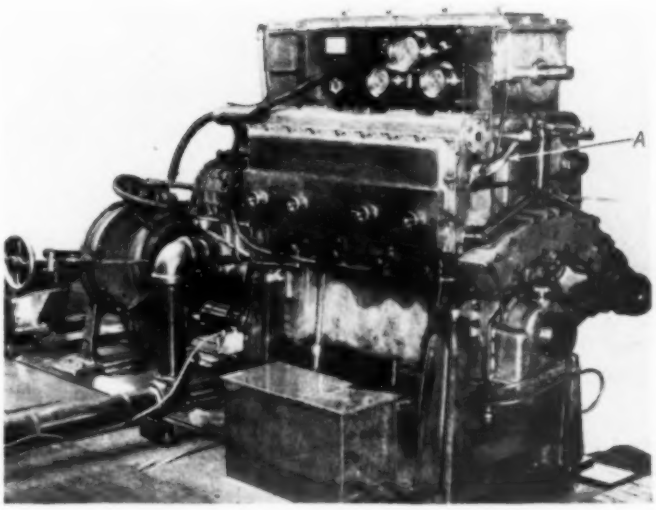


Fig. 3—View of the engine showing the positive pressure blower at the left and the control handle at A

block with intake and exhaust manifolds, combustion and water chambers, was a single casting. An experimental casting was made to this design and sawed through the center as shown at Fig. 1 to note metal thickness in various parts and check up generally on the construction.

However, on account of the extraordinary amount of work involved and the many unnecessary hazards incident to making such an exceedingly intricate mold, the pattern was split longitudinally along the center line in Fig. 2, and a pair of half cylinder blocks, one right and one left, were cast from the changed pattern.

The word pattern in this connection is used rather loosely, since the entire pattern equipment was made up of coreboxes. The outside of the mold was formed in dry sand cores and the vast number of interior pockets were formed by cores made from an oil sand mixture, in many instances vented with wax vent rods.

Anchoring Provides Problem

Problem of anchoring many of the cores without the aid of chaplets added to the difficulty of producing a casting to withstand pressure tests, and one free from internal fins that might interfere with circulation of water or air.

By actual count 176 separate cores entered into the construction of each casting. Since this was an original job, no jigs or gages were available. In many instances the cores had to be fitted in a clay thickness in the mold, then removed, the mold cleaned out and the core returned to place. Gages for reassembling the pasted cores were made during the preliminary fitting.

Intricacy of the interior chambers limited the number and extent of the core prints that could be used without interfering with the construction. These small and limited number of prints had to carry a greater load than usually is considered satisfactory practice. This was one of the reasons for forming (*Please turn to page* 49)

Place de la Opera, one of the many beauty spots of Paris, 1932, International Congress city. Illustrations courtesy French Line

Fourth International Congress

Will be held in Paris from Sept. 14 to 17

following pre-convention tours of France

PARIS, France, holds the center of world foundry interest during September, when on the 13 to 17th the fourth international World Congress of Foundrymen will attract visitors from all participating countries. While economic conditions have prevented the formation of a large and representative party representing the American Foundrymen's association, that society will be officially present in the offering of an exchange paper and by designated members of the association.

The congress, comprising technical sessions, will occupy Tuesday to Saturday of the week of Sept. 11, while an exposition of equipment and supplies will be offered at the Parc de Expositions, Porte de Versailles, during a period of two weeks including the days allotted to the convention. This exhibition will comprise foundry equipment and supplies from France and many other European countries.

Tours have been arranged to precede and follow the congress. These will start Sept. 9 and terminate Sept. 26 and have been planned to include the principal manufacturing cities and many of the scenic and historic spots of the country. During these tours and the stay in Paris special entertainment features have been provided and many events of interest to the ladies of the party have been arranged.

M. Eugene Ronceray, president, Association Technique de Fonderie de France, is president of the administrative council of Bonvillain et Ronceray Co.

The congress will be preceded by a dinner and reception and dance for members attending, to be held Tuesday evening, Sept. 13. The following morning the official opening is scheduled for the Sorbonne, followed by a luncheon and formal inspection of the exhibition, and technical sessions. Thursday morning will be devoted to plant inspections followed by technical sessions. Friday will be similarly divided between factory inspection visits and afternoon and evening sessions. The latter is to be a joint session with the French civil engineering society. The entire day of Sept. 17 is to be given over to technical sessions, closing with a joint meeting with the Comite des

Forge and the closing ceremonies. Sunday the delegates to the congress will be received by the President of the French Republic.

Embraced in the formal proceedings of the congress is the American Foundrymen's association annual exchange paper, "Some Practical Foundry Considerations for Improving the Soundness and Aluminum Alloy Castings," by H. J. Rowe and L. M. Gingerich, Aluminum Company of America. British and Belgian exchange papers also will be given. The complete list of papers is as follows:

"Some Practical Foundry Considerations for Improving the Soundness of Aluminum Alloy Castings," by H. J. Rowe and E. M. Gingerich, Aluminum Co. of America, American exchange paper; "A Few Causes of Defects in Aluminum Alloy Castings," by Dr. D. Hanson, University of Birmingham, British exchange paper; "Contribution to the Study of the Expansion of Sand Molds and Cores," by J. Varlet, Societe Metallurgique Esperance, Longdoz and president of the Technical Committee of the Association Technique de Fonderie de Belgique, Belgian exchange paper; "Core Oils," by M. Doskocil, Czecho-Slovak exchange paper; "Loam Molding," by M. Fabre; "Bronze Furnaces," by M. Dennery; "Hydraulic Binders in the Foundry," by Louis Maillard, Societe des Acieries d'Ugine; "Metallic Case-Hardening and the Possibility of Its Utilization in the Foundry," by M. Laissus;

"Study of the Mechanism of Corrosion by Acids in Gray Cast-Iron," by M. Girardet and M. Tsou-Ren-Kou; "The Desulphurization of Cast-Iron, Experiments in Desulphurization by Solvay Sodium Carbonate with or without Additions," by M. Girardet and M. Lelievre, Usines de Pont-a-Mousson; "Production of High - Duty Cast-Irons by Superheating and by Refining in the Low-Frequency Induction Furnace," by M. Levasseur; "Considerations on the Qualities and the Elaboration of Metal in the Manufacture of Steel Castings in the Open-Hearth Furnace," by M. Roger, Compagnie de Fives-Lille; "Study of Cast-Irons With Low and Very Low Carbon Content Made in the Cupola," by Dr. G. Delbart and M. Lecoeuvre, Societe Cail;

The Madeleine, classic as a Grecian Temple faces the swirl of varied traffic

Inseparable as the Seine from romance and beauty of Paris is the cathedral of Notre Dame

"Mass Production of Cores Without Core Wires or Arbors by the Use of Core Machines," by M. Biry, of Societe Sculfort et Fockedey; "Some Results of Mechanical Tests on Cast-Irons," by Professor A. Portevin; "Applications to the Steel Foundry of Electric Furnaces With Acid Lining," by M. Lemoine; "Technical Factors of Instability Special to Over-Specialized Foundries," by M. de Fleury; "Aluminum Bronzes," by M. Meigh; "The Manufacture of a Rectangular Tank of 7 Tons in Cast-Iron," by M. Simorre; "Effects of the Thermic Treatment of Black-Heart Malleable," by M. Leroyer; "Special Cast-Irons," by M. Guillet and Dr. Ballay; "Nitriding of Cast-Irons," by M. Guillet; "Oxygen Occlusions in Cast-Irons," by M. Cournot, A. Le Thomas and Mlle. Haim;

"Influence of Molybdenum on Cast-Iron," by M. Cournot and M. Challansonnet; "Influence of Titanium on Cast-Iron," by M. Challansonnet; "Influence of Nickel and Chromium on Malleabilization of Cast-Iron," by M. Thiery and Mlle. Lacroix; "Influence of Aluminum on Cast-Iron," by M. Ploye; "Castability," by M. Courty; "Graphitizations of Cast-Irons at Moderate Temperatures Between 400 and 600 Degrees Cent.," by A. Le Thomas and M. Morlet; "Graphitizations of Cast-Irons at High Temperatures Between 600 and 1000 Degrees Cent." by A. Le Thomas and Mlle. Le (*Please turn to page* 57)

The historic river Seine is flanked by boulevards and beautiful buildings

High Test Cast Iron

Proprietary methods and the addition of various metallic and nonmetallic alloys give high results

By R. S. MacPHERRAN

Allis-Chalmers Mfg. Co., Milwaukee

THE first of the treatments described in the previous section of this article appearing in THE FOUNDRY for July, is now in commercial operation under patent claims. The latter is more or less tentative. There would seem to be a field here for development and one in which the alloys might be of service. However, the low cost of steel castings, may limit this process.

Meehanite cast iron for which high physical values are claimed, is made in the cupola, electric and air furnace, and involves the use of calcium silicide. The process covering the use of basic earth silicides is patented both in this and European countries. When made in the cupola the process makes use of over 75 per cent steel scrap. By the technique of manufacture and the application of the process of decomposition of excess carbides and controlling the physical constitution of the remaining carbides, metallurgical control is positive. In other words, it is claimed that not only does the process accurately control graphitization and produce a given graphite content at will, but the form of the graphite is equally well under control no matter what the size of section of the casting may be.

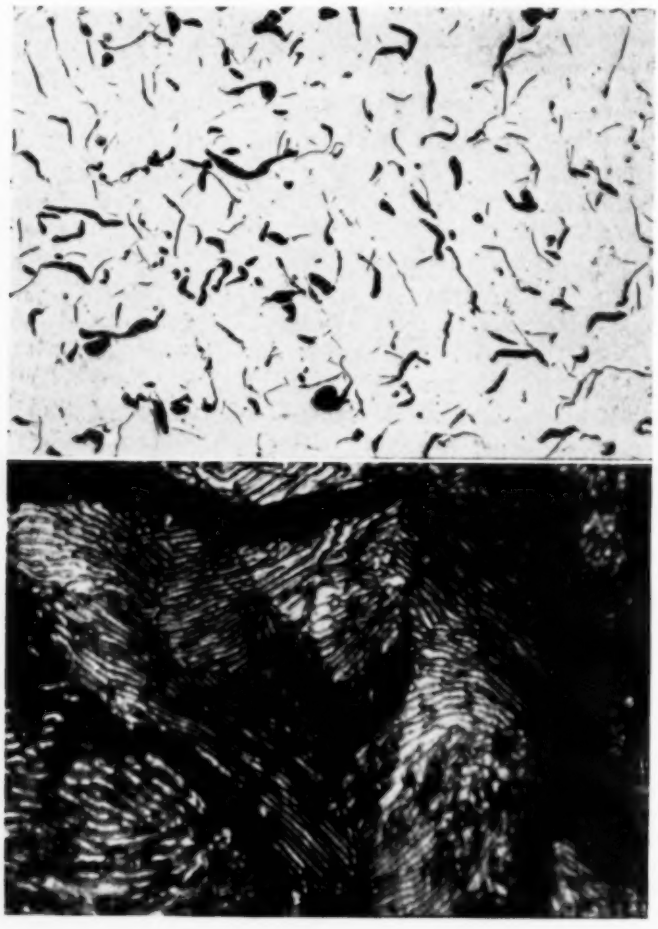


Fig. 5—(Left)—Micrographs of cupola iron as cast with a tensile strength of 73,700 pounds and brinell hardness, 285. The upper magnified at 100 and the lower, 2000 diameters. The analysis is as follows: Total carbon, 2.64; silicon, 2.14; sulphur, 0.08; phosphorus, 0.08; manganese, 0.69 nickel, 1.12; chromium, 0.08 and molybdenum, none.

The metal *Ermalite* also should be mentioned. This is a patented metal which does not require heat treatment. It is made in an air furnace of the reverberatory type and melted in baths of 120,000 to 140,000 pounds per melt. Representative physical properties which have been reported are as follows: Ultimate strength, 50,000 to 65,000 pounds per square inch; 1 to 2 per cent elongation in 2 inches; arbitration bar transverse test—12-inch span, 5000 to 6000 pounds; total deflection at center, 0.35 to 0.45 inches brinell hardness ranging from 230 to 240.

This iron is comparatively easy to machine, being slightly tougher than gray iron.

The average chemical composition of this metal is that of the following analysis:

	Per cent
Total Carbon	2.40-2.60
Graphitic Carbon	1.60-2.00
Combined Carbon	.60- .80
Silicon	1.90-2.00
Manganese	.40- .45
Sulphur	.07- .09
Phosphorus	.15- .17

Other similar patented processes could be described, but these few are believed to be sufficiently representative to serve as illustrations.

The practice of adding steel to cupola mixtures is of course old. As service requirements became more severe, the percentage of steel was

increased until in 1913 the foundry cupola record of Allis Chalmers company shows that a mixture of 60 per cent steel was in use. The analysis of the resulting iron was approximately as follows: Carbon, 3.00 to 3.20 per cent; silicon, 1 per cent; sulphur, 0.120; phosphorus, 0.30; and manganese, 0.80, and it was used for castings requiring good wearing surfaces.

The standard arbitration test bars made from this mixture were either white or mottled and as such were not suitable for test. A thicker test bar would have been serviceable for this iron. Specimens cut from liners cast 1½-inch thick broke at from 38,000 to 40,000 pounds tensile strength per square inch.

Finely Divided Carbon

Some few years ago the germ or nuclei theory of carbon particles became fairly well established. The natural reaction of many foundrymen was to reduce the number of these nuclei in the iron going into the cupola by reducing the percentage of pig iron charged and by increasng the percentage of steel. This first was done by running a mixture of nearly all steel with just enough ferrosilicon to make it come out of the cupola containing 1 per cent silicon. By this procedure, it was thought to keep the metal free from graphite nuclei. The iron then was deoxidized and grayed in the ladle by the addition of ferrosilicon, ferromanganese, and shot nickel. The iron produced by this method is close grained and strong.

This procedure has been modified in our own foundry by adding most of the ferrosilicon and ferromanganese in the cupola with only a small amount of ferromanganese-silicon added in the ladle. The *F* ingot nickel may be added in the cupola or ladle. When added in the ladle, the nickel is preheated to a dull redness before adding to the partly filled ladle. In our experience, the use of nickel shot is to be avoided, especially for large ladles.

Molybdenum, when used, is added to the stream of iron in the spout in the form of powdered ferro-molybdenum. The alloy used contains 60 to 70 per cent molybdenum and is readily dissolved by the hot iron. No difficulty has been experienced with its use. The addition of nickel or molybdenum facilitates machining, increases the brinell hardness, and adds somewhat to the tensile strength. It is our practice to add 1 per cent nickel or 0.35 per cent molybdenum. However, the 1 per cent nickel, will have more effect on machining properties than the 0.35 per cent molybdenum. As the cost of molybdenum per pound is approximately three times that of nickel, the cost per ton of iron is the same regardless of which alloy is used in proportions mentioned. By this method no large amount of cold material is added to the iron in the ladle. While the freedom from neuclei may not be quite so complete as when following first described procedure, we find there is a greater certainty of the iron being in condition to use.

Steel Percentage Increased

In discussing making high test iron by the cupola process in this country, it should be remembered that almost all American cupolas are operated without a forehearth. Naturally this requires tapping at intervals, between which the iron backs up in the cupola in contact with the coke. Therefore, the carbon pick-up is much greater and consequently there is greater difficulty in obtaining a low carbon iron in the ladle than if a forehearth were used. To avoid this difficulty there has been an increasing percentage of steel added to the mixture.

For this and for other reasons some of our foundries now are using a tilting Y-shaped spout in front of the cupola tap hole. This spout makes it possible to run the iron down either leg, or side, as desired and allows the stream of iron to be continuous for it is not necessary to stop up the cupola. It has been reported by those using this process that mix- (*Please turn to page* 61)

Fig. 6—(Right)—Micrographs of cupola iron as cast with a tensile strength of 70,200 pounds and brinell hardness, 277. The upper magnified at 100 and the lower at 2000 diameters. The analysis is as follows: Total carbon, 2.64; silicon, 2.16; sulphur, 0.084; phosphorus, 0.08 manganese, 0.73; nickel, none; chromium, 0.08 and molybdenum, 0.34

Questions and Answers

Covering important problems found in all phases of modern foundry practice

This department includes problems relating to metallurgical, melting and molding practice encountered in making castings. Questions addressed to the Editor of The Foundry will be answered by members of the editorial staff, supplemented where occasion requires by the following advisory staff: Steel, John Howe Hall; Malleable, H. A. Schwartz; Gray Iron, John W. Bolton; Nonferrous, Charles Vickers.

Spongy Area May Result From Insufficient Metal Head

We are making sheave wheel blanks 7½ inches in diameter with a 6-inch face. When the grooves are machined we find shrunk, spongy places where the rim joins the web. The mixture we are using is composed of 150 pounds of pig iron containing 3.07 per cent silicon; 150 pounds of foundry returns, and 200 pounds of cotton mill machinery scrap.

We believe that your difficulty with the spongy areas may be due partly to the iron and partly to the lack of sufficient head of metal. Rough calculation shows that your mixture gives iron with 2.40 per cent silicon, and it is suggested that you reduce it to about 2 per cent by increasing the machinery scrap and reducing the pig iron, or replacing part of the latter by steel scrap. Presumably you are gating the casting on the hub, but the cope is shallow which does not give sufficient head. The top of the sprue should be at least 4 inches and preferably 6 inches above the highest point of the casting.

Casting Skin Smoothness Not Dependent on Riddle Used

We find that we can mold most of our castings satisfactorily by screening our facing through a No. 2 riddle. On certain classes of work the molders insist that for fine surface they must use a No. 3 riddle. Inasmuch as all our facing is riddled at the mixer through a No. 3 riddle, it does not seem necessary to us to riddle it again for any other purpose than to fluff the sand, and that a No. 2 riddle will attain the desired end. Can you give us any light on the subject?

Since the facing sand is screened through a No. 3 riddle at the mixer, we do not believe it is necessary to screen it again through the same size riddle at the mold face, unless the facing sand is subjected to conditions which would cause it to pack before use at the mold side. In that case there would be a tendency for the sand to form larger particles. Usually however, facing sand is handled in such a manner that there is little tendency for packing between the mixer and the mold side.

As you state the main use of the riddle is to fluff or aerate the sand, and to remove any lumps which might be formed. In addition to that service the riddle performs another function, and that is to break the fall of the sand on the pattern which prevents the formation of hard spots on the mold face. Also, the pattern receives a uniform thickness of facing sand which while resulting in economy of facing sand, mainly prevents excess use of the fine facing sand which reduces the permeability of the mold.

Good Melting Practice May Eliminate the Hard Spots

We are troubled with hard spots in castings of 88-10-2 alloy. We use all new metal and try to use all care possible in molding, yet from time to time hard spots show up. Some of the castings are in the shape of a cleat having two feet. A plate is used from which four are cast. Three of these might be all right, and the feet on possibly the fourth one would be so hard they would be difficult to drill and countersink. Can you tell us the reason for this trouble?

To make an alloy of 88 per cent copper, 10 per cent tin, and 2 per cent zinc, you first melt the copper under a layer of charcoal. When it is quite liquid add zinc and stir well adding about 2 ounces of phosphor copper to 100 pounds of the metal. Stir thoroughly. Next the tin is added and well stirred in. Put on more charcoal, close the furnace and bring the metal to a good heat. If you have a pyrometer to gage the temperature of the metal, bring it up to 2300 degrees Fahr. Remove the metal from the furnace to the skimming hearth.

By the time the crucible has been skimmed and stirred, and fixed into the shank it will be near 2200 degrees Fahr. at the mold side. That

is a good temperature at which to pour the casting unless it is a thick and heavy one, when it can be poured a few degrees cooler say, about 2150 degrees Fahr. If you have no pyrometer it is necessary to guess at the temperature, and that is not satisfactory.

Pouring as mentioned, we have not the least idea where the hard spots come from, or why there should be hard spots, seeing that new metal is being used. We would suggest the alloy be carefully made as stated, with no variations, and then the casting will come perfect each time if they are molded properly.

Hard Ramming Is Cause Of Defects in Trolley Wheels

We are having trouble getting good castings for trolley wheels. The alloy is 94 per cent copper, 5 per cent tin and 1 per cent zinc. The defect is that the outside groove of the wheels is pitted, which shows up in the machining. We have poured the metal at different temperatures but can't seem to locate the fault. Can you give us any suggestions that will correct the trouble?

In all probability your difficulty with the trolley wheels is due to the molding sand comprising the outside of the wheel being rammed too hard, and the metal will not lie quietly on that part of the mold. Our suggestion is that it be rammed softer, or that a coarser sand be used. Use a No. 1 grade of molding sand for the entire wheel and gate with horn gates on each hub of the wheel. A trolley wheel is a simple casting to make and the alloy mentioned ought to be good enough. Add 2 ounces of phosphor copper to each 100 pounds of metal.

Cast Iron Grinding Lap Should Be High in Phosphorus

We desire to make iron castings weighing from 10 to 50 pounds each which are used as laps or tools for grinding curves on lenses. We believe that the iron should have a Rockwell hardness number 100-B, and possess marked porosity. The hardness will prevent too rapid wear, and the porosity will retain the loose emery which is fed onto the laps.

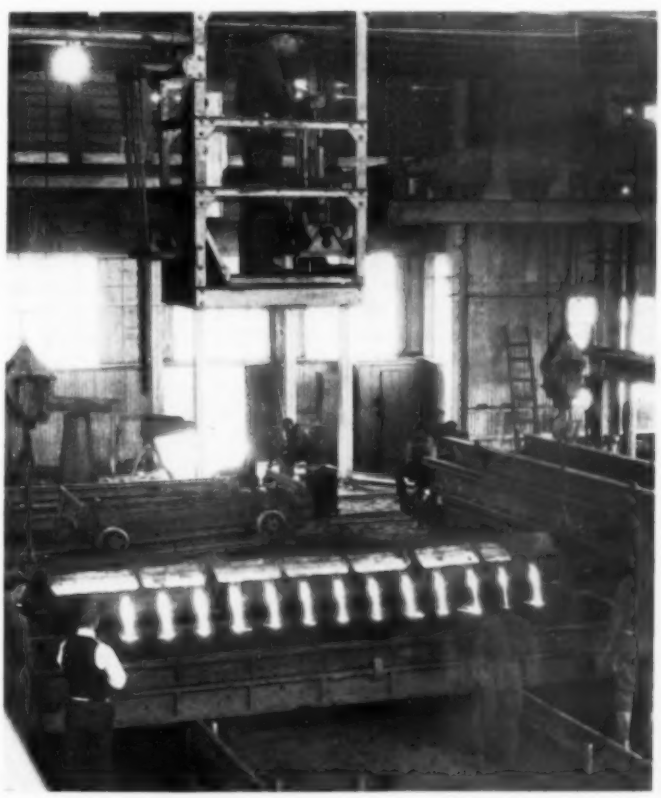
While we do not have data on its application to laps, we believe that a high phosphorus, fairly open-grained iron should be the thing for them. The iron should contain at least 1 per cent phosphorus. Such an iron will have little, high abrasive spots of hard steadite which usually will prevent too rapid wear, while the low spots of more open grained iron will hold the abrasive material fed onto the lap. It is suggested that 2 per cent silicon and around 3.50 per cent carbon, and 1 per cent or better phosphorus be tried. Use of high phosphorus iron has been found excellent in sugar mill rolls which, without an unusual amount of that element, wore smooth too rapidly. The hard steadite constituent prevented rapid wear, and the softer portions between the steadite spots offered a good gripping surface to seize the cane and pull it through the rolls.

Brass Borings Remelted By Several Different Methods

We would like to know the best method of handling brass and bronze borings. Is it more economical to remelt the borings which are brought up to a standard analysis and ingoted, or is it better to use a certain percentage in each heat with virgin materials? Also if using remelted borings and turnings, what precautions must be observed, and what is the usual loss in the low melting point components? We expect to use borings in crucibles from 100 to 200 pounds capacity.

Method of handling the borings and turnings will depend upon the quantity to be used up. It takes longer to melt borings than solid metal, and with a large output of borings to be absorbed, the heats would be slowed down to a point where it would be impossible to supply the desired quantity of molten metal. Therefore, another furnace will have to be used for borings alone which are ingoted. A large capacity electric, open flame furnace or large crucibles may be used. Turnings and borings are bulky, and a pot full of them will only give half a pot or less of molten metal.

With a moderate quantity of borings, perhaps the most economical way to handle them is to prorate it according to the number of crucibles. Place the borings on the bottom of the pot, and place a deepener on the top. Then put in the copper part of the charge which will be protected



An interesting method of pouring horizontally cast pressure pipe. The iron is poured simultaneously the entire length of the pipe

from the flames by the deepener. After the metal is molten, the deepener is removed, and the temperature of the metal is increased to permit addition of the white metals. The temperature at that point is too hot for pouring, but after skimming, and carrying to the floor, it will have dropped to the proper pouring point.

Dense Gray Iron Used for Smelting Pots

What is considered a good mixture analysis for cast iron pots and kettles for use in smelting zinc, lead, etc.; also for chemicals and for sulphur? We make kettles for various plants and some of them complain that they do not last long enough.

Since you do not give any information on the section thickness of the pots it will be impossible to give any specific data on suitable analyses or mixtures. In general it may be stated that it is necessary to use a dense, close-grained iron which is low in total carbon, low in phosphorus, and fully pearlitic in structure. Low total carbons may be obtained by the addition of about 40 per cent steel in the mix, and that addition also will aid in lowering the phosphorus content.

Graphite Blocks Used in Making Molds

Where can information on the use of graphite molds for nonferrous metals be secured?

Use of graphite blocks for molds for nonferrous metals is a patented process, and is described in U. S. patent No. 1,172,506. There are two kinds of artificial graphite available commercially, and that used for the molds is called graphitic carbon. It is distinguished from the other type by being soft and unctuous, and easily cut with a knife. The material may be purchased in round, square, and rectangular rods of various sizes up to several feet in length.

The block of graphitic carbon from which the mold is to be made should be sufficiently large to allow a thickness of about 6 inches all around the mold cavity, and for that reason the block may be formed of several pieces carefully machined on the contacting surfaces, and doweled together. Graphitic carbon may be used as a chill for one portion of the mold. Usually, graphitic carbon molds are rammed up in green sand for additional support. In any case since the material absorbs moisture from the sand, it is necessary to heat it sufficiently to drive the moisture off before pouring in the metal. That may be accomplished easily by placing a couple of red hot ingots in contact with the graphitic carbon mold a few minutes before pouring.

Cores in Ports Are Hard to Remove

I am forwarding a fragment of core taken from the steam port of a cylinder, 16-inch bore, 24 inches in length. These port cores become converted into a dense mass presenting great difficulty in removal from the casting. They are made from a mixture containing Jersey silica sand 18 parts, Albany bench sand 13 parts, bonded with one part core oil and blacked with a good silver lead. Castings are poured from a mixture containing steel scrap 30 per cent, pig iron 30 per cent and gray iron scrap 40 per cent and which conforms to the following approximate analysis: Silicon 1.50 per cent, sulphur 0.025 per cent, phosphorus 0.13 per cent, manganese 0.62 per cent. I shall appreciate your opinion on how to prepare cores that will come out of the castings readily.

To remedy the trouble increase the refractoriness of the core sand mixture. SInce this involves certain definite features it may be advisable to touch on the cause of the present trouble, before suggesting a suitable mixture. Any core that is entirely, or almost entirely, as in the present instance, surrounded by metal is subjected to compressive action as the metal cools. Small, thin cores are raised to high temperature of surrounding metal, a temperature high enough to fuse the clay binder. Under the ensuing pressure the partly fused mass is compressed to a smaller and naturally, a denser volume.

The obvious remedy is to reduce the fusible element to a minimum and provide means for the core to assume smaller volume without a correspnoding increase in density. The ideal core is one made from clear silica sand without any, or with practically no clay bond. This core is bonded with a binder which leaves a minimum amount of adhering film between the grains of sand. Artificial vents in addition to the natural interstices between the grains, provide a means for the mass to shrink into smaller volume.

Due to the peculiar shape of the port core, the coremaker is tempted to use a generous amount of molding sand in the mixture. The molding sand supplies the green bond which enables the core to hold its shape while in the green state. Unfortunately, while serving admirably as an agent for preventing the core from sagging, this same molding sand under the influence of intense heat becomes changed in character and prevents the ready removal of the core from the casting.

In an open, porous core, or one in which large vent passages are provided, the artificial bonding agent is consumed by the intense heat and the disintegrated grains of sand run readily from the casting. In other cores where venting facilities are not so ample, binder is not consumed, but undergoes a change similar to that which coal undergoes in a coke oven.

Bearing the foregoing points in mind you can secure satisfactory port cores by omitting all or nearly all molding sand from the mixture. A false frame filled with black sand will support the core while it is green. The amount of oil used at present, one part to 31 is not excessive, although many foundrymen claim a higher ratio. Continuous wax vents about 2 inches apart and extending from end to end of the core will insure open vent passages with a consequent free escape of the gas and combustion of the binder.

Leaks in Valves Caused by Thin Sections

We are sending you a section of a ½-inch valve casting which leaks at the points indicated. The mixture used contains 88 per cent copper; 10 per cent tin; 2 per cent zinc; 1 per cent lead and 1½ per cent nickel fluxed with 2 ounces of phosphor copper before pouring at 2250 degrees Fahr. High heads are used, and the metal is composed of carefully selected heavy copper wire, ingot tin, pipe lead and zinc. Melting time is 1¼ hours in an oil-fired, crucible furnace. The valves are subjected to 300 pounds steam, or 600 pounds hydraulic pressure for superheated steam, water, oil, etc.

First we suggest that more care be taken in cleaning cores before placing them in the molds as loose sand has fallen into the crevices. While it may not be the actual cause, it is possible that some of the leakage may result from such dirt. To our mind there is not enough stock allowed on the threaded portions of the valve for a full thread. If that were attempted with the present design, the thread would cut into, and weaken the valve body at that point. We also believe that you will obtain better results by increasing thickness of the valve all around. While your alloy may be satisfactory, it is suggested that for these high pressure valves, you use the so-called standard acid metal containing 75 per cent copper; 8 per cent tin; 15 per cent lead, and 2 per cent phosphor-tin containing 5 per cent phosphorus. Pouring temperature is important in reducing the percentage of leakers. The temperature of 2250 degrees is about right.

Viewing Foundry Developments

At Short Range

—Courtesy Charles Perry Weimer

SEVERAL users of the balanced blast cupola, a development of the British Cast Iron Research association, report a fuel ratio of 14 to 15:1, irrespective of size. One operator having a 27-inch bore cupola melting 3 tons an hour and operating 10 or 11 hours a day with a charge carrying about 30 per cent of steel, has reduced the coke consumption over one-third, and a cheaper coke of a higher sulphur content is being used without increasing the sulphur content of the castings. Another member, maintaining careful records, had an average loss of castings over a ten year period of 4.4 per cent, and with the balanced blast cupola the loss for a year has been 0.7 per cent. Improvement is attributed to hotter and cleaner metal free from excessive oxidation.

♦ ♦ ♦

Coating the silica brick of open-hearth ports with a layer of either magnesite or chrome cement affords greater resistance to the attack of oxides in the furnace gases and prolongs their life.

♦ ♦ ♦

IN ANTICIPATION of the return of legal beer, breweries are showing much interest in stainless steel as a metal for successful application in the form of fermentation vats, storage tanks, yeast pans, cooling coils, containers, valves and other units. Stainless steel it is said has been found to have no effect on the flavor, and it does not impart any turbidity or haziness to the beer. Breweries in Switzerland recently have used stainless steel containers, in place of wooden barrels, for shipping beer. Furthermore, in the past, bottled beer only could be pasteurized; this operation was not possible with wooden barrels, because of lack of heat transfer with the wood. Swiss breweries, due to the use of stainless steel containers, now are able to pasteurize beer.

♦ ♦ ♦

Reports from Germany indicate that strontianite, an ore containing strontium carbonate, is being employed successfully to reduce sulphur content in steel for castings. The strontianite is used like fluorspar, and it is said that a reduction of over 50 per cent sulphur is attained.

♦ ♦ ♦

A central Pennsylvania producer of steel castings and forgings has effected an appreciable economy by the elimination of overhead crane cages. The cranes are now operated from pulpits located at floor level, thereby permitting crane operators to perform additional supplementary work.

♦ ♦ ♦

CAST iron containing 15 to 25 per cent chrome has been recommended for heat resisting parts, such as grate bars, annealing boxes, furnace parts, rabble arms for roasters, etc. It is said to have high resistance to oxidation and also to abrasion at high temperatures. This chrome-iron alloy is being produced in the cupola without large losses of chromium. Oxidation tests made at 1832 degrees Fahr., over a period of 48 hours, showed 24 per cent loss in weight for ordinary gray iron. There was no loss in weight for chrome-alloy iron. In fact, in the same test, the 25 per cent chrome-cast iron showed a gain of 0.07 per cent and the 15 per cent alloy a gain of 0.14 per cent. These gains resulted from the oxygen in slightly oxidized surfaces.

♦ ♦ ♦

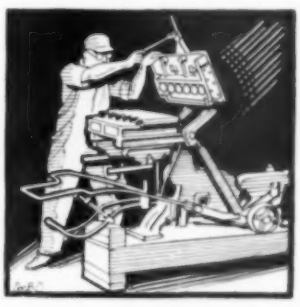
A magnesium alloy recommended for castings requiring good strength without heat treatment contains 93.7 per cent magnesium, 6 per cent aluminum and 0.3 per cent manganese. For high strength heat-treated castings, an alloy of 91.8 magnesium, 8 per cent aluminum and 0.2 manganese is used, and for heat treated castings where yield strength and hardness are of greatest importance, the alloy contains 89.9 per cent magnesium, 10 per cent aluminum and 0.1 per cent manganese.

♦ ♦ ♦

CORRECTION—An item on this page in the July issue told of a combination front wheel brake drum and hub cast in one piece. A higher brinell hardness is obtained through the addition of 0.25 per cent molybdenum to the base mixture, rather than with the addition of malleable, as was stated in the previous item.

♦ ♦ ♦

INCEASES in size and speed of automobiles has directed considerable attention to braking problems. Manufacturers have found pressed steel drums unequal to the demands placed upon them in service, and following the lead of an



old time manufacturer of fine cars, are turning to castings. Cadillac now is using a cast iron drum which shows the required characteristics. The metal is melted in an electric furnace and shows a tensile strength of 60,000 pounds per square inch in the casting.

♦ ♦ ♦

Development of special welding rods now permits welding high manganese steel castings, containing 10 to 14 per cent manganese. It also now is possible to weld such cast parts to structural steel by a procedure of applying the special welding rod to the casting, standard rods to the structural steel and then welding the two welded sections together.

The FOUNDRY Family Photograph Album

Upper Left

MAJ. PIERRE NICOLAU
France

Upper Right

H. F. SEIFERT
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

Lower Left

W. W. KERLIN
Gray Iron Institute
Cleveland

Lower Right

BEN R. MAYNE
American Malleables Division American Brake Shoe & Foundry Co., Owosso, Mich.

Men of Industry

Whose Activities Are Making Foundry History

EDWARD R. WILLIAMS, for several years vice president, Vulcan Mold & Iron Co., Latrobe, Pa., has been elected president and director of the company succeeding his father, the late Col. Edward H. Williams. Mr. Williams was associated with his father in the conduct of the Vulcan company since its inception

E. R. Williams

in 1923, having previously obtained his experience in the steel and mold business with the Youngstown Sheet & Tube Co., Youngstown, O., and the Valley Mold & Iron Co., Sharon, Pa. He was graduated in 1921 from the Sheffield Scientific school, Yale university, and during the war was enrolled in the officers training corps there.

The post of vice president has been left vacant for the present. H. H. SMITH is secretary and treasurer and the board of directors is composed of W. M. SAXMAN, C. M. SEMLER, G. E. ANDERSON, FRED B. MCFEELY, ROY C. MCKENNA and Messrs. WILLIAMS and SMITH.

WILLIAM H. SHULTE has resigned his position with the National Engineering Co., Chicago, following the completion of the installation work in which he was engaged.

Mr. Shulte was in the molding machine department of the Arcade Mfg. Co. from 1909 to 1919. Later he was employed for several years by the American Foundry Equipment Co. as factory superintendent, following which he was superintendent for a short time for S. Cheney & Son Co., Manlius, N. Y. He then became connected with the National Engineering Co. as superintendent in charge of installation and field work. During that time he handled extensive installations in this country and abroad including equipping a tractor foundry for the Soviet Union at Leningrad. During all of this time Mr. Schulte has served the American Foundrymen's association at its exhibitions as superintendent in charge of installing exhibits.

WILLIAM R. BECK, until recently manager of sales engineering, Fort Pitt Steel Casting Co., McKeesport, Pa,. has been made sales manager for the iron and steel foundries of the Atlantic Steel Foundry Co., Akron. Mr. Beck was graduated from the Case School of Applied Science, Cleveland, in mechanical and metallurgical engineering. He served as molder, coremaker and steel blower before embarking on sales work. He operated an iron foundry in Detroit during and after the war and for eight years served as manager of sales for the Massillon Steel Castings Co., Massillon, O.

ALFRED C. HOWARD, manager, E. & T. Fairbanks Co., East Moline, Ill., a subsidiary of Fairbanks, Morse & Co., has been appointed assistant to A. E. Ashcraft, recently made vice president in charge of all manufacturing of the parent company, with headquarters at Beloit, Wis.

JOHN BEST, until recently foreman for the Pennsylvania Bronze & Brass Co., Philadelphia, has been made superintendent of the Barry Bronze Bearing Co., Camden. Mr. Best, following his apprenticeship with the Miller Lock Co., Philadelphia, was employed by Eynon-Evans Co., Baldwin Locomotive Works, Frankford Arsenal and the Pennsylvania Bronze & Brass Co. He was made foreman for the latter organization in 1923.

L. A. GRAHAM and M. A. CARPENTER have been appointed sales manager and sales promotion manager, respectively, for all commercial products of the Falk Corp., Milwaukee. Foundry sales remain under the direction of A. SIMONSON, vice president.

L. A. Graham

Mr. Graham has been vice president of the Low-Graham-Wallis Co., Chicago, technical advertising agency, and sales manager of the Garford Truck Co., Lima, O. He has been doing consulting sales work for the Falk Corp. Mr. Carpenter has been in charge of advertising for the Falk Corp. as well as the sale of certain Falk products.

V. S. VEENMAN has been made foundry superintendent for the France Foundry & Machine Co., Toledo, O., in charge of jobbing and production bronze and aluminum castings. Mr. Veenman formerly was foundry foreman for the Superior Bronze & Aluminum Co., Warren, O.

Reader's Comment

Interesting communications from readers of The Foundry

EDITOR'S NOTE—*Material Appearing Under this Head Does Not Necessarily Reflect the Opinion of* THE FOUNDRY *or of Its Editors.*

Include Steel

TO THE EDITORS:

An engineer of a local manufacturing company, which does not operate a foundry but buys castings from various sources, called recently to discuss what he considers a grave situation, which was intensified by an article in the June issue of THE FOUNDRY. He stated that the product manufactured by his company requires quality castings which must be machinable and possess a tensile strength of at least 40,000 pounds per square inch. One foundry supplies an *alloy iron*, another a *high test cast iron*, while another provides a *pearlitic iron*. The engineer points out that the best castings which they have received were made from a 50-50 steel mixture with a percentage of molybdenum included and were billed as semisteel.

The engineer believes fully in the use of alloys in cupola iron, but his experience shows that the best castings are made with steel in the base mixture. Since writers on the subject seldom refer to steel in alloy irons, he believes that something should be done to guide foundrymen, especially the younger men who are likely to be misled by the article "Molybdenum in Gray Cast Iron" which appears on page 20 of the June issue of THE FOUNDRY.

The only reference to steel in the article is made casually on page 58, first paragraph, center column, as follows "and even in high steel cupola iron carefully made."

As the engineer, like the writer, is an old timer he is interested in foundrymen receiving the latest and best information available. After showing him numerous micrographs of semisteel, which we matched with the unetched micrographs shown as Fig. 1 on page 21 of the June issue, he thought it advisable to write this letter. The micrograph of a 40 per cent semisteel mixture, with no alloy, is enclosed, shown as Fig. 1 in the accompanying illustrations. An examination of the micrographs show the graphite is in the ball and hook form, which the authors of the article claim to be due to molybdenum, and which others claim is due to nickel and chromium and other alloys. We have learned that formation is due to steel.

A micrograph of a metal which will receive considerable attention in the near future, and now known as a manganese semisteel, also is included. (Shown as Fig. 2) Results thus far are astonishing. The silicon and manganeses almost balance, with silicon at 2.07 and manganese at 2.02. The charge for that metal contains 30 per cent of steel.

Since some have learned the advisability of mentioning the use of steel scrap, I am asking you to suggest that writers on the subject kindly include information on the use of steel in the mixture.

DAVID MCLAIN,
McLain's System, Inc.
Milwaukee

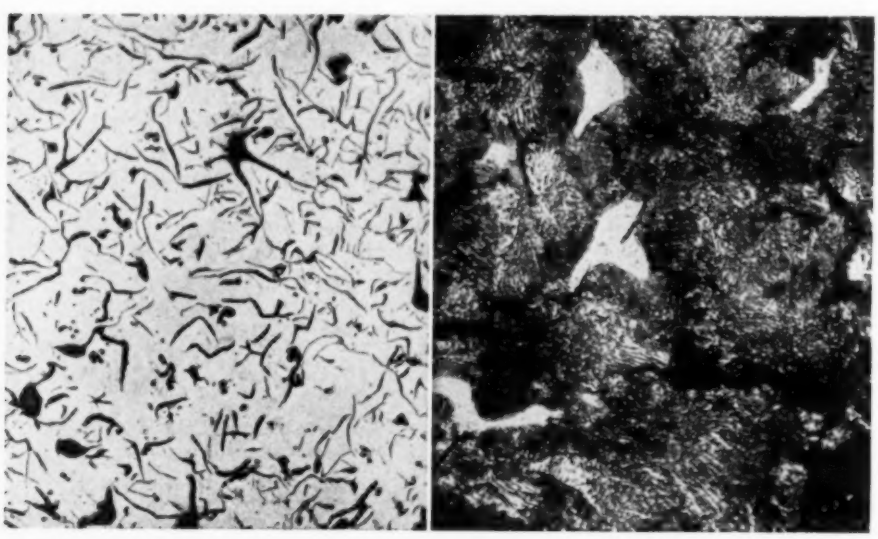


Fig. 1 (Left)—Forty per cent semisteel mixture showing graphite in the ball and hook form, x 100. Fig. 2 (Right)—Manganese semisteel, x 500—Illustration by courtesy of R. S. MacPherran

Real Good Pointers

TO THE EDITORS:

I have always enjoyed THE FOUNDRY. Always read from front to back. The new issue is a good one, a "humdinger" as some of us would say. Have always said a real foundryman should read THE FOUNDRY every issue and get some real good pointers. Congratulations on the good work.

B. T. WALLACE
Detroit, Mich.

Proves Progressive

TO THE EDITORS:

Please accept my congratulations on the "new" FOUNDRY, which seems to prove the progressive spirit of its editors.

J. H. HRUSKA
Berwyn, Ill.

Expensive Economy

TO THE EDITORS:

The present policy seems to be, among foundry owners, to employ inefficient, cheap executives for the duration of the depression. To cite a few cases, and I could mention a good many, consider the following:

Foundry *A* in the east is having trouble with four and six cylinder heads for automobile engines. These are crooked and warped and could be corrected very easily if a real foundryman advised them that they were shaking them out too soon.

Foundry *B* in the Cleveland district was operating profitably two years ago and showed a monthly record the highest in the company's 40 years of business with less than 2 per cent scrap on heavy work. A successful foundryman who was in charge was dismissed about 18 months ago and the foundry now is being run by a salesman. Scrap losses have mounted to from 20 to 50 per cent.

Foundry *C*, called upon to make a rush repair engine liner in loam, the simplest kind of a job to produce in this manner, where losses should not exceed one per cent, was obliged to make three before a good one was produced. On other work this shop makes castings that have not changed in 20 years, but the scrap loss is four times what it was several years ago due to the fact that the present, low-salaried, foundry superintendent lacks experience.

An adequate proof of the lack of

(*Concluded on page* 36)

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Albany, N. Y.

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ability under which many foundries are now supervised is shown by the very elementary questions asked through various publications, notably one paper which is established upon a policy of broadcasting questions. Ninety per cent of these questions are so simple that they become ridiculous. It makes one sigh when he thinks how the art of gray iron founding has degenerated. I am 100 per cent for interchange of ideas and your question and answer department is fine. Keep up the good work. I am only pointing out that the questions asked through other publications prove that many come from inefficiently managed foundries.

A SUPERINTENDENT.

Every Improvement

TO THE EDITORS:

The new FOUNDRY is very fine indeed. It seems to me you have incorporated every improvement that could be thought of. The setup of the advertisements is very attractive. The style type used in the reading matter is excellent and you certainly are using fine grades of stock for the cover and inside pages.

EDWARD G. BORGNIS

Wauwatosa, Wis.

Urges Group Selling

TO THE EDITORS:

It is my belief that we should devote more of the time and effort that we now use in our various group meetings in discussing and organizing to combat the evils about which we have been talking. A little less time could be put on those worn out items of cupola practice and other things which we have almost worn out by talking about them in our meetings.

I believe further that groups of foundries could be formed in certain localities with the entire group selling its product through a central agency, with all selling for approximately the same prices. Each member of this group of course paying its share of expenses and receiving its share of the work. We always have heard that to have a group of foundries hold to fixed prices is a violation of law. Why do you not hear of that law when you buy gasoline for your car or milk for your children? How about the freight you pay on castings? The charge is the same no matter what railway is used.

We handle a line of valves and hydrants for city use and think nothing of it when a half dozen or more bid exactly the same price at a municipal letting. You can go over the list of necessities and find many items which all carry exactly the same prices even if they are sold in many different brands and made by many firms. Buy a repair part for your car and the clerk looks in a book for the price on any make of part. The prices are standard and they should be standard in the sale of castings. If we were all to sell castings at standard prices, we could all make some money on them even in bad times, those shops who could do the best work and make the best casting would get a larger share of the business and would deserve it.

Today I visited a jobbing foundry which is making manhole castings as its specialty. They also make a few furnace castings and stove parts, do a general line of jobbing business which includes light bench work. It would surely be better for all concerned if that foundry made only manhole covers and traded the light work to a light work shop in return for the few manhole covers and grates etc. which the light work shop is sure to be trying to make. A central selling agency such as I have in mind would act as a sort of clearing house in that respect. It is only a dream at present but such a thing is possible of being worked out.

I know of many instances where foundries in Milwaukee and other cities are sending work into Illinois, in fact our largest tonnage goes into the city of Chicago from several Wisconsin foundries, but I also know of many instances of castings coming into Milwaukee and Wisconsin cities from Chicago. Of course this is justified in many cases since our present day shops cater to a specialized demand. However, in the cases I have in mind this business of castings passing each other on the road is mostly brought about by price selling.

JACK DAVIS

American Castings Service
Milwaukee, Wis.

A. F. A. Publishes Transactions for 1931

The American Foundrymen's association, 222 West Adams street, Chicago, recently has published in book form Vol. XXXIX in its *Transactions*, covering the work of the association in 1931. In addition to all of the papers presented at the 1931 convention of the association in Chicago, the publication includes the reports of various committees and the board of directors. The book is exceptionally large, containing 964 pages.

Joins Engineering Staff

Charles H. Marshall, until recently a member of the technical staff of the Bell Telephone Laboratory, Inc., has joined the staff of Lucius Pitkin, Inc., New York, consulting chemists and metallurgists, as materials engineer. Prior to his service at the Bell laboratories, Mr. Marshall was in charge of the physical and mechanical laboratories of the Westinghouse Electric & Mfg. Co.

Elected President Of Foundry Supply Firm

Herbert T. Herr Jr., has been elected president J. S. McCormick Co., Pittsburgh, succeeding the late John S. McCormick, founder of the business. Mr. Herr was associated with Mr. McCormick for the past 9 years, first as sales manager, later as vice president and general manager in charge of sales and production.

Prior with his affiliation with the J. S. McCormick Co., Mr. Herr was associated with the Westinghouse Electric & Mfg. Co., East Pittsburgh,

Herbert T. Herr Jr.

Pa., of which his uncle, Edwin M. Herr, and his father, H. T. Herr, were president and vice president respectively. Mr. Herr served that company with the title of steam service engineer, after graduating from Yale university Sheffield Scientific school. Before entering college, he served in the U. S. field artillery during the war and previous to that was employed in the copper mines in Utah. Mr. Herr served his apprenticeship with the Westinghouse Co., and much of his time was spent working in the foundry.

Discusses Molybdenum

"Molybdenum" is the subject of economic paper No. 15, recently published by the U. S. department of commerce, bureau of mines, and prepared by Alice V. Petar. Information includes a general discription of properties, uses, history and methods of manufacture, domestic and foreign production and supply, markets, prices, etc. A bibliography also is included. Copies of the bulletin may be purchased from the superintendent of documents, Washington.

Lead Reactions in Bearing Metals

Sulphides or oxides present develop gases which the solid metal retains

By CHARLES VICKERS

BEARING metals usually contain more or less lead as a part of the alloy. For example, the following alloys for bearings contain lead: Seventy per cent copper, 10 per cent tin, 20 per cent lead; 77 per cent copper, 8 per cent tin and 15 per cent lead; and 80 per cent copper, 10 per cent tin and 10 per cent lead. Each of these alloys may or may not contain from 1 to 4 per cent of zinc, with a proportionate less amount of copper, without harm to the alloy. A possible exception is the alloy containing 20 per cent of lead, in which less zinc usually is considered advisable due to possible dropping of the lead during solidification of the alloy.

Zinc Promotes Solidity

Zinc is not harmful in the other alloys, but, in fact, is useful in promoting solidity. For example, the familiar alloy of 88 per cent copper, 10 per cent tin and 2 per cent lead should contain at least 2 per cent zinc, making the mixture contain 86 per cent copper, 10 per cent tin, 2 per cent lead and 2 per cent zinc. When zinc is incorporated the alloy is tractable in the foundry, but without the zinc the alloy will provide considerable trouble and loss.

The alloy, 88, 10, 2, has been known for 75 years or more in the paper mill trade, and its reputation as an acid resisting metal for paper mill work has been unexcelled. Regardless of whether the reputation was deserved or not, the formula could not be changed, regardless of the trouble it caused in the foundry. The author recalls an instance where a loss of 50 per cent due to leakers was encountered in the production of heavy valves. Nevertheless, no change was permitted in the formula, although the addition of 2 per cent of zinc was all that was asked.

The old foundryman, who had made *Old Perfection Bronze* for more than 50 years had passed away. It was pointed out that he had made castings of huge size right along without the least trouble, and it was hinted that the younger molders should be able to do likewise. The formula for the bronze was in the old books, and the company wanted to keep it without change. The reputation of the firm had been based on castings made from that formula for close to 100 years, and no change could be permitted.

Although the large digesters of bronze no longer were made, as another metal had supplanted the Perfection bronze, the other work to be made in that metal provided so much difficulty that a rapid turnover in men resulted, but all had about the same success or rather lack of it. One day one of the old digesters turned up as scrap and it was suggested that an analysis be made just to determine the composition. The analysis gave the following results: 84.29 per cent copper, 9.43 per cent tin; 0.95 per cent zinc, 4.98 per cent lead, 0.025 per cent sulphur, 0.038 per cent phosphorus, an altogether different alloy than was expected.

The old foundryman evidently had worked in the zinc and he also had found, no doubt, that plaster of paris is helpful as a flux. The information was a well guarded secret, and a good one. However, the leakage loss on valves had been stopped long before the analysis of the ancient bronze sample had indicated a change in composition, simply by using a flux of barium sulphate in melting the metal.

It is extremely important that oxidation of the metal be prevented in making such alloys, and a covering of a sulphate always is helpful in that case. Scrap containing silicon should not be allowed to get into the melt because it will cause trouble. There are four oxides of lead and it is singular that silicon reacts with only three of them. As far as experimental evidence has gone, it does not appear that silicon reacts with litharge, but that substance would not be present unless added. The lead oxide that would be present in the leaded alloy would be Pb_2O, the lower oxide, and silicon would react with that producing metallic lead and lead silicate. It is that silicate which produces the grayish powdery substance that shows in such castings.

The alloy of 80 per cent copper, 10 per cent tin, 10 per cent lead, is likely to contain oxides and sulphides in the form of copper sulphide and lead oxide which react:

$$2Pb\,O + Cu_2S = 2Pb + Cu_2 + SO_2$$
(Partial)

Excess sulphur gives lead sulphate and copper sulphide, with no reaction between them, but lead sulphate may be reduced by metallic lead liberating sulphur dioxide:

$$Pb\,SO_4 + Pb = 2Pb\,O + SO_2$$

It is doubtful whether lead sulphate can exist in alloys. However, Parry claims that lead sulphate and copper sulphide exist together without reaction. The remedy then seems to be the use of a sulphate flux on the metal. Certainly it worked in the case of the old Perfection bronze valves previously mentioned.

Forms Metallic Copper

If cupric oxide is present in an alloy of copper with lead and other metals, the oxide is reduced by the lead forming metallic copper and lead oxide. That reaction goes on and prevents the reduction of cupric oxide by copper sulphide with the production of copper and sulphur dioxide. If copper sulphide is present in that case, it is unchanged and exists in the metal together with lead oxide. However, that would not produce porosity. At 2372 degrees Fahr. and with low pressure (conditions of actual practice) the lead oxide and the copper sulphide are stable, since at that temperature any sulphur dioxide which may have been left or is being absorbed, is reduced to copper sulphide as follows:

$$2Pb + 2Cu + SO_2 = 2Pb\,O + Cu_2S$$

Therefore copper sulphide and lead oxide should remain in the metal as solids. When melting at high temperatures (1652 degrees Fahr.) and with sulphur dioxide at atmospheric pressure, lead sulphide and lead sulphate break up into sulphur dioxide and metallic lead. Also lead sulphide and lead oxide do the same. Therefore, if any sulphides or oxides are present, a gas is developed of which 80 per cent is retained in that particular form by the solid metal.

Prevent Losses with

Proper Gates and Risers

By PAT DWYER

PRACTICE of pouring metal into molds while in an inclined position is more prevalent in brass foundries than in foundries devoted to production of castings in other metals. As with practically every feature that departs from the normal, this trick of tilting the molds frequently is indulged in where it is not necessary. However, the idea is based on a solid foundation and if it is carried to extremes occasionally, it is a harmless gesture.

Expert brass founders attach great importance to keeping the sprue filled with metal. In a tilted mold with the gate at the lower part, a pool of metal acts as a liquid seal and prevents entrance of air even when the stream is irregular or even intermittent. Smoke, more prevalent with some alloys than others, has a better chance to escape from an inclined mold with an opening at the top. Metal spreads over the surface and fills an inclined mold more gently than it does in a flat mold. This is a factor which must be taken into consideration where for any one of a number of reasons, the metal has to be rushed into the mold at high speed.

Noted the Methods Used

A typical instance illustrative of this point happened in a foundry which had secured a large order for pipe flanges ranging in weight from 2 to 80 pounds. A hoodoo seemed to hang over the job. Almost all the castings presented a rough, wrinkled, seamy skin. Molding, melting and gating methods were tried in various combinations but without success. Manager, foreman, molders and melter were at their wits end when a hobo molder drifted in one day and started to work on one of the flange patterns. Naturally he noted the scrap castings, the methods practiced by the men on either side, and the condition of the metal.

Instead of doing in Rome as the Romans do, in this instance pouring cold metal slowly into an elaborate gate, he adopted a radical plan of his own. Despite the protests of other molders, he placed his first five molds on a slant, with a single gate at the lower end and a single riser at the upper end. He poured the metal as fast as he could drive it through the gate—and secured a set of perfect castings. Thereafter his method was adopted and carried out on all flange molds.

With hotter metal the molds might have been filled in a horizontal position, while under other conditions it might have been necessary to pour the castings in a vertical position. However, in this particular instance the slanted mold was regarded as the mysterious factor, the potent variable, the essential element of success. From that day to this every flange mold is poured while in an inclined position. No hard and fast rule is laid down, but the average inclination is 20 degrees from the horizontal.

Yellow brass is a more difficult metal than red brass to cast in sand molds. Zinc oxide smoke is in the atmosphere. Dirty castings result if the metal stream entering the mold is not controlled to prevent the condensed zinc smoke floating on the surface from entering the mold with the metal. The immense volume of vapor given off by yellow brass consists of steam, hydrogen and volatilized zinc oxide.

While combined with copper, the zinc attains a temperature above its boiling point, of 950 degrees Cent. (1742 degrees Fahr.). The melting point of copper is 1083 degrees Cent. (1981.4 degrees Fahr.). An alloy of copper 67 per cent, zinc 31 per cent, lead 2 per cent, melts at 895 degrees Cent. (1645 degrees Fahr.) but the pouring temperature is considerably above its melting point and therefore is higher than the boiling point of the zinc. Consequently the zinc distills out as zinc vapor which oxidizes immediately in contact with the heated air and produces the well known fumes.

Develop Film Rapidly

While on the subject of defects it is pertinent to point out that nonferrous metals develop a film or skin more rapidly than cast iron, therefore the form of defect known as a split is more prevalent among brass and bronze than among gray iron castings. In some instances this split is apparent on the outside of the casting. In others it is covered and is not revealed until after the casting has been partly machined. The split merely is another name for a cold shut, an area large or small in a casting where an almost invisible film prevents a perfect union between two bodies of molten metal.

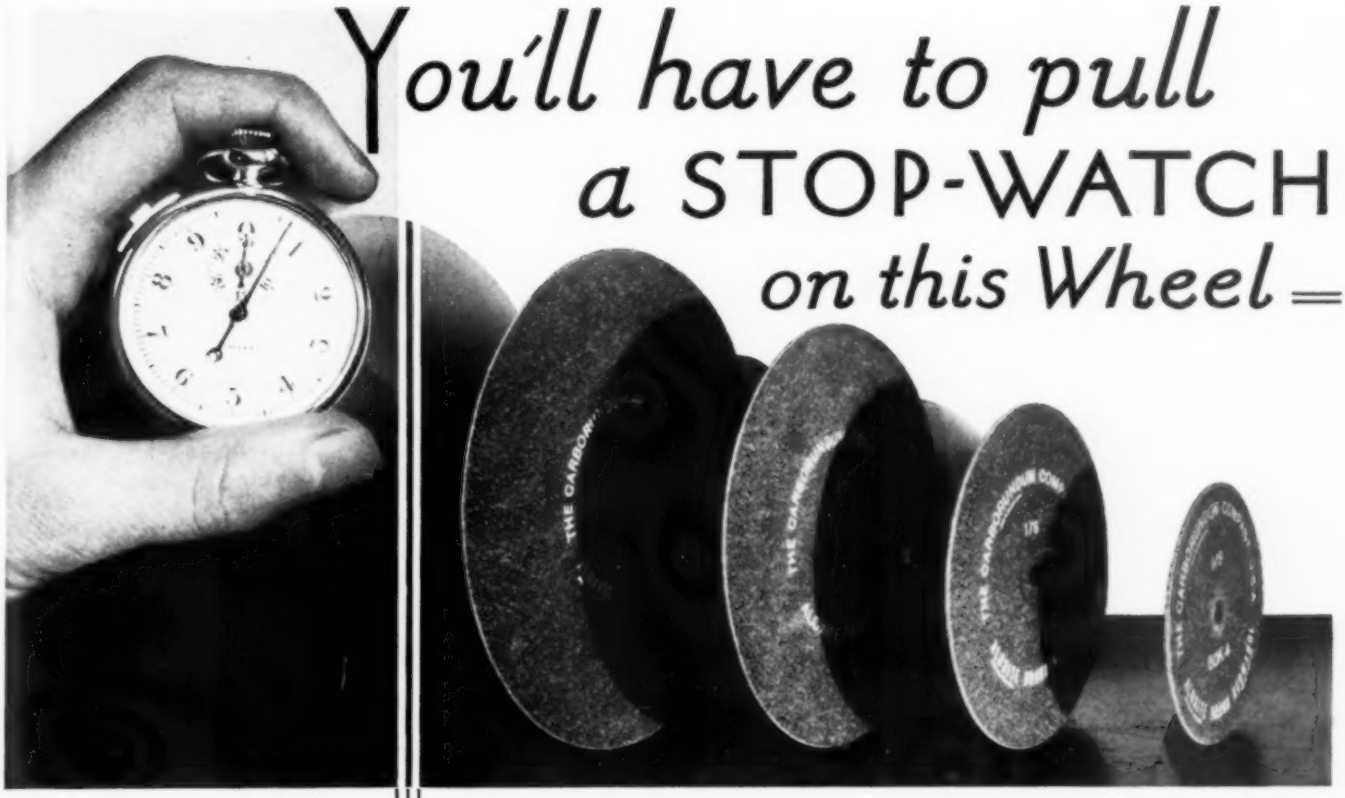
This film may develop through slow pouring, dull metal, ill designed gates, or through failure to keep the metal moving steadily in the mold. It is readily apparent that if the metal is held to a certain level in one part of a mold, until it rises to a corresponding level in another part of the mold —for example the hub and deep rim of a wheel—the film has an opportunity to form over the surface of the first body of metal. Thus when additional metal flows in, it fills the mold

(*Continued on page* 40)

Why Castings Leak

DEFECTIVE castings may result from any one of several causes, or may be due to a combination of several causes. In some instances the cause readily is apparent and the remedy easily is applied. In other instances only a patient process of elimination based sometimes on nothing more scientific that the old reliable method of trial and error, is required to hit positively on the cause, and to devise remedial measures. Coldshuts, that is thin films which separate adjoining bodies of metal, may develop through slow pouring, dull metal, ill designed gates or through failure to keep the metal moving steadily in the mold. Lack of uniformity in metal thickness between several parts of a casting may cause a migration of the eutectic from one part to another, with a consequent porous area between two sections. Contraction strains set up by the resistance offered by rigid molds or cores may cause the metal in certain parts of the casting to tear apart to a greater or lesser extent.

You'll have to pull a STOP-WATCH on this Wheel —



IT'S merely a matter of split seconds in timing the work of the Aloxite Brand Redmanol Cut-off Wheel.

In cutting of small bar stock—tool steels—cold rolled steels—stainless steel—even stellite—rods, tubing or spring stock—it takes on all comers in small dimensions—cutting without burr or burn at amazing speed.

For instance on the modern type cut-off machine this wheel will cleanly cut steel rods 1⅛ inches in diameter in 1½ to 2 seconds.

Comparable speed records are made on other metals.

And you can run this wheel with safety up to 16,000 S.F.P.M.

Made in standard sizes for all types of machines—in thicknesses of $\frac{1}{16}$, $\frac{3}{32}$ or ⅛ inch, depending on the diameter.

Aloxite BRAND Redmanol

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Cut-Off Wheels

[They Save Time — Save Stock]

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Sales Offices and Warehouses in New York, Chicago, Boston, Philadelphia, Cleveland, Detroit, Cincinnati, Pittsburgh, Milwaukee, Grand Rapids, Toronto, Ont.
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(CARBORUNDUM AND ALOXITE ARE REGISTERED TRADE MARKS OF THE CARBORUNDUM COMPANY)

(*Continued from page* 38)

cavity but does not break through the film. Under certain conditions, brass and bronze may be poured slowly, but as a general rule it is safer to pour them hard and fast and at a good lively temperature. Also in pouring many

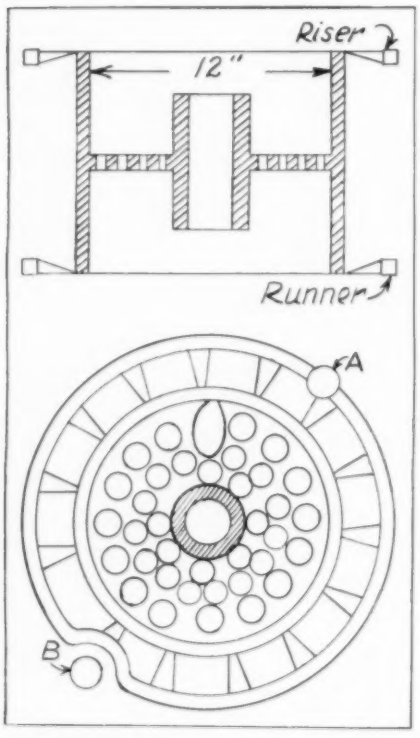

Fig. 167—A ring gate top and bottom prevented the casting from cracking

molds from the same pot it is well to remember that the temperature of the last metal is not as high as that of the metal poured into the first mold from the pot.

The temperature factor enters extensively into production of certain castings and gates must be designed with that factor in mind. In many instances a casting may be gated at the top, bottom, or side, with a small gate, a large gate or several gates. Any opening that will admit the metal to the mold may be used. In other instances the choice of gates is narrowed to a few, and in special instances only one type of gate can be employed. The type will vary in size depending on the amount of metal to be carried, but the basic feature and the method of application do not change.

An example is presented in Fig. 167, a monel metal piston for an oil meter. In general features it resembles a small web pulley, 12 inches in diameter, 8-inch face, 1¾-inch diameter, hub 6 inches in length with a 1-inch diameter core through the center. The web is ⅜-inch thick and perforated all over with ½-inch holes arranged in concentric circles. One opening 2 x 4 inches occupies a space close to one side. The rim is 5/16-inch in thickness. Despite its apparent simplicity, the job was given up by several foundries before a gating method finally was applied successfully.

Defect did not appear until the casting was partly machined. Then a crack was found at the junction of web and rim. This crack varied in different castings from one quarter to one half the circumference. The defect readily was recognized as a draw due to difference in setting time between the hub and the rim. All practical foundrymen are aware that recognizing the cause of a defect, and providing a remedy or a preventive measure, are two different things.

Although sometimes confused, the words *draw* and *shrink* are not synonymous terms. According to the dictionary *draw* means to pull; *shrink* means to reduce in volume, to make less. A draw, when applied to a casting, means an arrested contraction resulting in a fracture. A shrink, when used in the same connection, means a seepage of metal while in a molten condition, resulting in a cavity. In this particular instance the problem was to facilitate the contraction of the rim and to synchronize the contraction of hub, web and rim.

Poured at the Bottom

A ring of cinders was incorporated in the sand between the hub and the rim. This combination offers less resistance than a solid body of sand. Practically every size, shape and combination of gates and runners were tried without success until the circular spray or ring gate shown in Fig. 167 was tried.

The mold was made in a three-part 20-inch square steel flask with a sprue in each of two opposite corners. The sprue *B* passed through the cheek and carried metal to a circular runner at the bottom. From the runner the metal entered the mold through number of small gates which insured speed and uniformity in filling the mold. A similar set of gates at the top connected to the sprue *A* served as a riser, feeder and flowoff for the dull metal which had arisen through the mold.

With this combination the hottest metal was in the rim and as a result the cooling speed between the inner and outer parts of the casting were equalized and the contraction was uniform all over.

Patterns Must Be Good

In many instances the brass foundryman is not consulted by customers who prepare their own patterns. This is no handicap where the patterns and gating systems are prepared by expert patternmakers with practical foundry experience. It may prove a serious handicap where the foundryman bids upon a job and then is supplied with pattern equipment which does not measure up to what he expected.

The foundryman himself is to blame in many cases for retaining antique pattern equipment when better is available. To some extent it is natural he should hesitate, for metal patterns are expensive. However, advice of a metal pattern expert can be had for a nominal fee. Then a plan can be formulated for a gradual retirement and replacement to extend possibly over a period of years.

The metal patternmaker who lays out patterns on gates or on plates for quantity production should be familiar with the changes that take place while metal is passing from the liquid to the solid condition. He should know that first it forms crystals which usually have spaces between them that must be filled later by the constituent of the

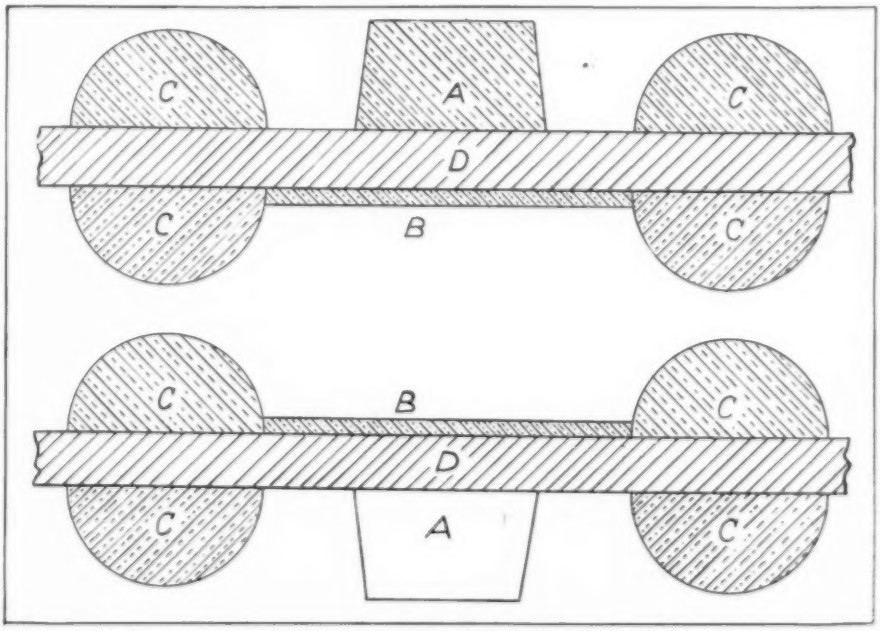

Fig. 168—A runner in the cope part of the mold is preferable to a runner on the drag side in feeding the castings

alloy with the lowest melting point, the last to solidify.

Metallic crystals do not fit like the cells of a honeycomb. They may bear regular shapes but they are orientated differently. When examined under a microscope the crystals present an irregular appearance. The eutectic generally is extremely fluid and can seep through the spaces between the crystals. Finally it comes to rest at the lowest point containing vacancies. From that point it rises to higher levels until it is all spent. If this happens before the crystals are sealed, the casting will leak under pressure at such points.

If the eutectic either drains away from the casting or is insufficient to fill the spaces between the crystals, pathways are left through which gas or liquid may be forced later under slight pressure. All leaks are not caused by molding or melting practice. Some are due to the character of the metal mixture. For example an apparently trifling amount of aluminum in red brass ingot will cause pressure castings to leak. On the other hand the tendency of some metals to leak is checked by the addition of a small amount of phosphorus, usually about ½ ounce of phosphor copper per 100 pounds of metal. The amount depends on the amount of zinc in the mixture.

A condition occasionally responsible for leaking or otherwise defective castings is shown in Fig. 168. Until a close examination by a competent man discloses the cause, the leaking castings are blamed on hoodoos, jinxes and other mysterious agencies beyond human control. Gates, runners and patterns are arranged on two pattern plates in an identical manner with the single exception that in one the runner is formed in the cope and in the other the runner is in the drag. Castings made from the plate shown in the upper part of the illustration almost invariably pass inspection. Castings made on the pattern plate shown in the lower part of the illustration, almost as invariably are rejected when subjected to a pressure test.

Change the Gates

A careful checkup shows that the position of the gates in relation to the patterns, also the area and volume, are the same on both plates. Apparently some other factor must be considered. Formulas are available for calculating the most effective size for gates, sprues and runners, but in many instances practical experience based on close observation is required to decide where and how the gate is to be attached to the casting.

In this particular instance the runner and gates deliver the metal satisfactorily on both plates. However, the function of the runner and gates does not end there. When the metal begins to shrink and solidify, the metal in runner *A* in the upper part of Fig. 168 sinks by gravity to compensate for the shrinkage. The same law of gravity sucks metal out of the castings *C*, the gates *B* and into the runner *A* as shown in the lower part of the same illustration. In foundry parlance the upper runner *A* is a feeder, while the lower runner *A* is a sucker, with the natural result that castings made from the upper plate are solid, while castings made on the second plate contain leaky areas.

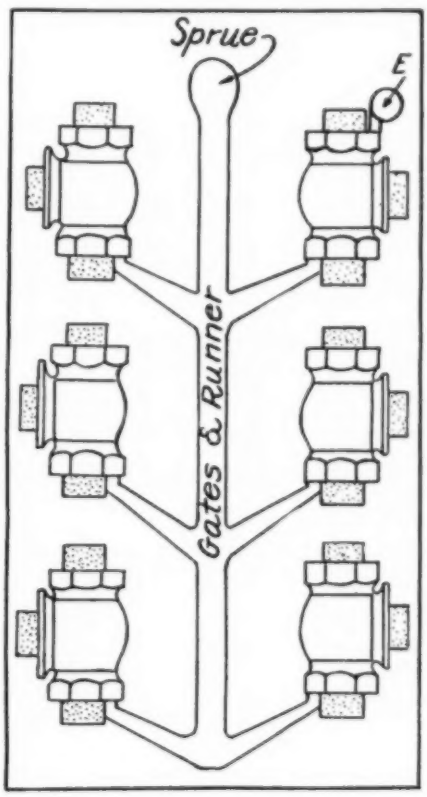

Fig. 169—On a tilted mold the position of the sprue may be the cause of leaking castings

The same general idea is illustrated in Fig. 169, a set of globe valves, with the gates slightly exaggerated for emphasis. This is a perspective view of the castings in the drag which was slightly elevated at the sprue end. All the castings made in this manner did not leak, but the leakers invariably showed the defective area at the end next the gate.

Some foundrymen attribute leakage to oxidation of the metal poured at a low temperature. Undoubtedly a certain amount of leakage can be traced to that feature, but certainly it was not responsible in the instance under discussion. If temperature was responsible, the leaks would not have been confined to the end of each casting next the gate. Oxide particles are scattered promiscuously. Eutectic drained from the castings by the gates naturally would leave porous areas in the vicinity.

The upper neck might draw a little from the upper heavy hexagonal end, but usually the effect is negligible. The metal in the neck and body solidifies before that in the upper end. In some instances, alloys with more than average shrinkage, metal poured at too low a temperature to feed itself properly, a sufficient amount of drainage from the upper head, might result in a crack to be revealed after the threads are cut in the end of the casting. Shrinkage of that kind usually can be prevented by placing a shrink bob on the upper flange as shown at *E* in Fig. 169.

Feeders are needed on top of the heavy flanges on some valves. Leakage on most of these castings is caused by fine hair cracks between the flange and the body of the valve. A stiff mold or a stiff core prevents the casting from contracting to a normal extent. The logical cure for defects of that kind is to redesign the pattern to provide a more uniform distribution of metal in the various parts. Usually in ill designed valves the metal in the neck and body is comparatively thin and for that reason it sets before the metal in the heavy flanges. Contraction imposes a strain at the junction and a fracture is the result. It may not be visible to the naked eye, but it will allow gas or liquid under pressure to leak through. Danger of eutectic draining to the bottom always is present with heavy flanges. Heavy feeders on top or cut into the flange at the joint may be necessary to counteract this tendency.

This is the thirty-second of a series of articles dealing with the various types of gates and risers used in the foundry industry. The thirty-third installment will appear in an early issue.—THE EDITORS.

Plan Symposium On Chemistry of Metals

A symposium on "The Physical Chemistry of Metals," will be held by the division of physical and inorganic chemistry of the American Chemical society at the society's eighty-fourth meeting at Denver, Colo., Aug. 22-26. Among the papers to be read are the following: "X-ray Analysis of Metals and Alloys," by G. L. Clark, University of Illinois, Urbana, Ill.; "Some Applications of the Fundamental Theories of Metals and Alloys to Practical Manufacturing Problems," by Anson Hayes, American Rolling Mills Co., Middletown, O.; and "The Influence of Small Impurity Concentrations on the Physical Properties of Metal Single Crystals," by Alexander Goetz, California Institute of Technology.

General Alloys Co., Boston, has appointed the Cleveland Duplex Machinery Co., Penton building, Cleveland, its representative in the Cleveland district. G. J. Hawkey is head of the Duplex organization, which will handle service as well as sales.

Successful western foundryman provides a specialty of making

Deliveries When Promised

WHEN E. R. Hinton, vice president and manager of the Olympic Steel Works, Seattle, promises a customer that his castings will be shipped at 10 a.m. Monday, the customer can proceed with whatever contingent features he has in mind, safe in the knowledge that the castings inevitably will leave the foundry on the dot, or maybe a little before the second hand on the old reliable stop watch crosses the aforesaid dot known as 10 o'clock on land and as 4 bells at sea. A man of his word, E. R., makes no promise lightly, but once the word is passed, it is kept to the letter, even if it keeps him—or his men—up all night.

Watches Seattle Develop

Although not one of the original settlers of Seattle, he has lived there 27 years, and has watched the marvelous development of this northwest Pacific seaport and transcontinental railway terminal with the keenest interest. Up to the age of 21, this interest—intense and patriotic and all that—was held somewhat in check by scholastic duties, but once he attained his majority he took a man size grip on the job as may be noted by a careful perusal of the following activities:

Vice president Seattle Rotary club July 1, 1931—June 30, 1932.

Treasurer and member of the executive committee Associated Industries of Seattle past three years.

Director Tower Savings Bank, past two years.

Active in Community Fund movement since it was established in Seattle.

Member of the American Foundrymen's association since his entry into the foundry industry.

An ardent member of the United Metal Trades association of the Pacific Northwest he served as chairman of the Washington district from 1927 to 1928 and as president of the association from 1928 to 1929.

Mr. Hinton was born in Mankato, —certainly not! The second *a* is as in cat, hat, bat and sometimes in tomato—Minn., March 22, 1897, but by the time he arrived at the age of 7 he decided that the Pacific Northwest and particularly the up and coming town of Seattle offered a wider and more becoming field for the exercise of his talents. Behold him then in 1904 giving the city what is known as the once over. Apparently the scrutiny was satisfactory on the part of E. R. as the party of the first part, and on the part of any citizens who may have noted his arrival, as the party of the second part.

Great place for parties, Seattle!

If Mr. Hinton was superstitious—which he is not; or if he believed in astrology—which he does not—he might regard the month of March in a more favorable light than the remaining months of the twelve. And why should he regard this particular month with favor? Certainly a fair and pertinent question and worthy of an answer showing the same characteristics.

He was born—if you were not skating past too rapidly you might have seen this statement about three paragraphs back—he was born in Minnesota—Mankato with the sharp *a*—in the month of March, and survived! 'Twas in the month of March, exactly 21 years after the first memorable March, that is to say in March, 1918, that he first became identified with the Olympic Steel Works in the capacity of shipping clerk. Shortly afterward, the scope of his duties was enlarged to include those of castings inspector and supervisor of all cleaning room activities.

Upward Climb Goes On

Less than two years later, during a six month leave of absence on the part of the vice president and general manager, Mr. Hinton was appointed acting manager. In 1921 he was elected secretary of the company and member of the board of trustees. In 1923 he was appointed manager of the plant and has continued to serve in that capacity up to the present. He served as secretary until June, 1926, when he resigned to take office as vice president and treasurer.

A busy kind of a lad, you say to yourself. Does he never take any time off to play?

In moderation, yes, in moderation. Business comes first, but when the occasion offers, he can play as blithely as any of the young creatures who trip around the maypole and announce to all and sundry that they expect to be crowned queen of May, mother, queen of May—as if either you or I cared!

E. R. Hinton

E. R. does not trip around the maypole, but he likes to make an occasional trip around the golf course with a driver in one hand and a spare ball in the other. It is violating no confidence to admit that up to the present he has not qualified as a runner up or challenger for any of the amateur championships and the sterling pieces of useless silverware awarded the victors. Fishing! Ah, that is a different story. He has fished practically every stream and lake in Washington and also has dragged the big flopping sea trout and salmon out of Puget Sound. However, fishing for orders is his specialty, orders to be delivered on time.

Federal Specifications board, Washington, recently has adopted specifications covering purchases of departments and independent establishments of the government of foundry pig iron, bronze pipe fittings, high test gray iron castings, gray iron castings, malleable iron castings, aluminum ingot.

Uphold Quality

IN this distressing period, there is a business evil growing under cover—the decline in quality in manufactured products. Prices of raw materials have dropped with disastrous rapidity. Manufactured articles had to follow the trend, of course, and the resultant pressure has been terrific. In the struggle to keep abreast of the times—and in some cases ahead of them—many less careful manufacturers are sacrificing quality in order to meet prices. We mince no words in stating that such a policy is a long step toward ruin for the firm practicing it.

We have seen no clearer exposition of this situation than [illegible] excerpt from an ad[illegible]

—Editorial,
"Metal Industry", June, 1932.

Uphold Quality

And Keep Melting Costs At The Minimum!

FOUNDRY authorities agree that no other method of melting can give the high quality metal obtainable with plumbago (graphite) crucibles and associated melting equipment.

But do *you* know you can get high - quality crucible - melted metal . . . at the lowest melting cost? The facts prove it.

Crucible furnaces require the lowest initial investment, with lowest burden in carrying charges, and lowest depreciation.

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Lava Crucible Co. of Pittsburgh, *Pittsburgh, Pa.*
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Gives Crucible Quality, Flexibility, Adaptability, Reliability and Economy

Melting Costs for Various Furnaces

Outline designed for nonferrous melting but is also applicable to ferrous metals

By H. E. WHITE
Lava Crucible Co. of Pittsburgh

FREQUENTLY a foundry operates several different types of melting units and the cost of melting is bulked so that it is impossible to ascertain any difference in cost of operating any one of several individual furnaces. Different alloys are melted in various units with a frequent unfair distribution of an average melting cost for the entire foundry. Alloys difficult to handle should receive a higher prorata melting charge.

Factors Govern Selection

Various factors naturally entered into the original selection of the different units. It is possible that if the costs are known clearly an entirely different set-up would be made. It might be found economical to sacrifice some units in favor of others.

In analyzing melting costs it was found certain conditions tend to prevent reduction of various cost data compilations to strictly comparable units. The following are probably most frequent and effective in distributing the comparisons:

1. Items for which total charges remain more or less constant, regardless of output (such as general labor, general maintenance and general plant overhead) are affected by conditions in a given set of analyses to be compared. In general the several furnace installations will be operated at different percentages of full capacity and seldom at 100 per cent. Where any one unit causes unusual increase in general items it should assume those charges.

2. Each classification of melting equipment may, within itself, show variations in melting costs due to differences in per-charge capacities of furnace units. Furnaces of the same type but of different sizes must be considered independently.

3. Composition and physical character of metals and relative amounts used in the different furnaces will affect unit costs.

4. In most analyses, melting losses will constitute an important cost item and in many cases its value will determine the relative standing of different types of melting units. It also is the item which is most difficult to analyze with precision and therefore permits upsetting variations. Determination from inventory analysis is direct and should provide a satisfactory average of extended periods of operation, but it is probable that few foundry accounting systems are so set up as to permit segregation of classes of losses for which each type of melting equipment and each class of metal or alloy is responsible. Determination by test at each furnace confines the item to actual melting losses, but there is the possibility that too few tests will be made to give a satisfactory average value. It is next to impossible to allocate reclaimed metal credits to various individual units.

Due to the pre-eminent part played by metal loss and the controversial feature it has become, careful study of that feature is necessary. Naturally metal loss depends primarily upon skill of the operator, but there are inherent features in different types of melting equipment which affect that item independent of the skill of the operator most experienced in any particular type of furnace.

Importance of some system for standardized determination of losses and comparable reporting of same therefore is demonstrated plainly. To make the definition of metal loss

Table I

Unit Melting Costs Total

	Cost $	Output Tons	Cost Per T	Total Items
1. THERMAL ENERGY (per furnace per heat)				
a. Melting equipment				
b. Preheating equipment				
2. LABOR (per man per day)				
a. Melting				
b. Preheating				
3. REFRACTORIES				
a. Crucibles (per crucible)				
b. Linings (per furnace per year)				
c. Covers (per furnace per year)				
d. Electrodes (per furnace per year)				
e. Other items				
4. GENERAL MAINTENANCE (per furnace per year)				
a. Melting equipment				
b. Preheating equipment				
5. AUXILIARIES (for furnace per month)				
a. Blowers and pumps				
b. Other items				
6. FIXED CHARGES (per furnace per year)				
a. Melting equipment				
Depreciation				
Interest				
b. Preheating equipment				
Depreciation				
Interest				
TOTAL (less metal loss)				
7. METAL LOSS				
Debit .....% of 2000 pounds at $..... pound.				
Credit				
Net loss				
TOTAL (including metal loss)				

all inclusive and comparably applicable to any set of foundry conditions, it appears decidedly complicated. Where conditions are under exact control, such as in the laboratory, the proposition may be simplified and fewer items involved.

A suggested outline for determining metal loss for individual units and metals is as follows:

Metal Loss Formula

a. Total weight of charge—by direct weighing.
b. Percentage of metal in charge—by analysis. This item is important in field determination because dirty scrap, oily turnings, etc. may form part of the normal charge.
c. Metal poured as ingot or as castings plus gates and risers—by direct weighing. This is assumed as clean metal; occlusion of gases, if any, is neglected.
d. Skimmings and skull—by direct weighing.
e. Percentage of metal included and combined in skimmings—by analysis.
In skimming care should be exercised to pick up the minimum amount of included metal.
f. Spillage, if any—by direct weighing.
g. Volatile metal loss g will then be

$$g = ab - c - de - f$$

Per cent metal loss L can be expressed in percentage as

$$L = \frac{100\ (g \text{ plus } m\ d\ e)}{ab}$$

in which m is a constant representing the ratio of difference between purchase price of a clean metal and sale value of metal in dross to the purchase cost of clean metal. This will vary with locality and condition.

Since volatilization loss is determined indirectly as the small difference between two relatively large quantities, a fair degree of precision in the determination of those quantities is indicated.

Application of the formula requires chemical analysis and it may not be considered practicable for field work. However, it contains the necessary elements to be considered in determining metal loss and as melting costs seem to hinge on that feature, some system such as this is recommended.

In using the proposed method correctly the following precautions should be observed: Thermal energy charges must be allocated equably. Should a unit which is a large consumer of thermal energy allow a low demand charge; when considering units using a low proportion of this energy, the charges should be based on demand charges commensurate with their requirements.

Similarly general labor charges should also be considered as some types of melting equipment require a greater proportion of general labor than others.

General maintenance items must be scrutinized carefully as the more elaborate types of melting equipment contribute heavily to general maintenance cost items and auxiliaries.

It is recommended that at least monthly and preferably annual cost figures be used. However, that is not adamant.

Pours Steel in Pressure Castings

(*Concluded from page* 13)

intended for general service, medium and soft grades is applied only when definitely specified in the order. It is not required on hard grade castings for general service. In this form of test, the specimen must bend cold without cracking on the outside of bent portion around a pin 1-inch in diameter. Medium steel must bend to at least an angle of 90 degrees. Soft steel must bend around the pin to an angle of at least 120 degrees without showing any indication of crack or rupture on the outside surface.

Test bars shown in Fig. 3 were cast from a steel falling in the soft range 0.22-0.25 per cent carbon, and yet the tensile strength is 74,000 pounds per square inch, the reduction in area is 52 per cent and the elongation in 2 inches is 34 per cent.

The bending test has been exceeded to an extraordinary degree. The ½-inch round bars *B* and *E* have been twisted and tied in knots involving bends sharper and more extended than any taken around a 1-inch pin. The rectangular bar ½ x 1 x 14 inches shown at *D* was coiled around a ½-inch pin for five full turns. Another bar of the same kind shown at *C* was doubled and redoubled into six loops without showing any sign of a crack on the outer face. The two straight bars *A A*, ½ x 1 x 14 inches were given between three and four complete twists. The entire surface of all these test bars is as clean and smooth and free from rupture of any kind as before the twisting and bending operation began. All bars were bent while cold.

Harry E. Orr, melting superintendent and the author who is metallurgist, the Atlantic Foundry Co. are responsible for the development of this special steel and stress the importance of the following points in working heats in an electric furnace:

1. Skilled knowledge to care for the furnace bottom, refractories and mechanism.
2. Selection and use of good scrap of known chemical analysis, free from any alloys or inclusions which would adversely affect physical properties of the casting.
3. Arrange the charge so that the bath will show the desired chemical analysis when melted. This will eliminate excessive use of iron oxide for boiling out the heat.
4. Keeping a good action in the bath during refining period.
5. Keeping slag at proper viscosity and composition during preparation of heat.
6. Close control of metal temperature to prevent excessive reduction of silica.
7. The first slag is skimmed and the metal covered with a second cleansing slag.
8. Proper use of manganese during refining period.
9. Omit aluminum or other unnecessary final deoxidizers.
10. Control of final chemical analysis.
11. Control of pouring temperature to suit the type of casting.
12. Proper heat treatment of finished steel castings.

A mold for a typical casting for high pressure service is shown in Figs. 1 and 2. On account of its size and weight this mold was made in dry sand, but the majority of the smaller castings are made in green sand molds. In this instance a sprue at the far right conveys the metal to two gates, one at the bottom of each of two adjoining flanges. An auxiliary gate is cut at the joint to the same two flanges. The most noticeable feature of these illustrations to a steel foundryman, is the entire absence of brackets connecting the flanges of the mold to the body. Skilled molding and melting practice have rendered their use necessary.

Uses Idle Capacity To Manufacture New Line

Faced with a sharp contraction in demand from its usual sources of business the Pettibone-Mulliken Co., Chicago, recently seized the opportunity to engage idle plant capacity by the manufacture of equipment hitherto foreign to its various products.

A few months ago the company started building motor truck trailers, and this business since has grown to become an important adjunct to its other activities in the production of railway track material, gray iron, manganese steel and other special alloy steels. The company was in a position to do the bulk of the fabricating work necessary.

More recently the company entered the road machinery industry, announcing development of its power maintainer, a machine for heavy-duty maintenance on gravel, dirt, stone, sand, clay and oil roads and weighing 12,500 to 14,000 pounds. This equipment has been in production for a short time.

Tie Patternmaking To Production

(*Concluded from page* 15)

be made in the existing patterns.

This order, in addition to specifying the part number and so on, supplies other information which is of great value to the pattern supervisor. From it he knows approximately what the yearly production requirements will be for that particular piece of pattern equipment. That gives him his first line on the type of pattern equipment which he must supply. The amount of money to be spent is governed largely by expected production.

If production requirements are large, and it is decided that the casting should be made on a sand slinging type of molding equipment, it will require the more durable type of equipment a cast-iron pattern. Perhaps production requirements are limited and will not warrant making the casting on that type of molding equipment and, for the sake of economy, that would mean building a mahogany pattern and steel-facing any of the more delicate edges or parts that might be subject to wear.

Establish Procedure

Thus the type of pattern equipment is selected. At the same time, the pattern man decides what type of equipment will be used—whether the casting will be made by hand, on a jolt—strip-squeeze machine or on a sand slinging type unit.

Next the method of constructing the pattern and core boxes is considered keeping the work of producing the casting and the later machining operations in mind. At this point it might be well to mention that after the type of pattern equipment is decided upon, an estimate is submitted to the department head for approval before actual work is started. Upon completion of the pattern equipment, a comparison is made betwen the estimated and actual cost of the job.

To facilitate manufacturing still further, a complete knowledge of machine shop set-up is necessary for it will be seen that the design of pattern equipment and the method of molding are governed to a large extent by the readiness with which the castings can be machined and later assembled into the completed tractor.

Since our aim is not to show how patterns actually are made, but rather to point out the pattern shop's place in the manufacturing set-up, and how it functions, we may omit the actual job of making the patterns, and assume that the sample castings specified in the original order, Fig 2, have been made. Inspection is the next step, and the inspector's report Fig. 3 is an important check against actual production performance later on. The sample castings, incidentally, are held for a reasonable length of time and may be referred to in the event of difficulty in the foundry or in the machine shop.

Pattern equipment is valuable property; therefore a record card, shown in Fig. 5 and 6, is kept for each of the parts. It shows the various engineering changes which have been made, the number of pieces required to make the complete pattern equipment, and also the pattern location at all times. For example, the lamp-bracket pattern referred to in Fig. 5 was taken to the foundry on March 10, 1931 and was returned to the pattern vault 6 days later. On April 15, 1931 it was sent to the pattern shop for the alteration indicated under "Pattern Cost and Alterations," and on May 9, 1931 it was sent out to a vendor. Actually, few castings are bought outside, but this step is shown on the card to indicate the various moves which patterns can make.

Other information completes the picture. From it the foundry production clerk is able to get all the equipment data he needs each time a production order for castings comes through, thus lessening the chance for error.

It will be noted that the vault location is included in this information. Important as it is to have the right patterns, it is equally important to keep them in good condition and to know where you can lay your hands on them the instant they are wanted. Standard steel shelving was chosen as best suited to the storage job. The vault is two stories high, the second floor being reached by stairs which fold up against the ceiling when not in use. Steel grating is used for the second floor. It simplifies the cleaning job and makes for good housekeeping. Patterns not in frequent use are kept on the second floor, and naturally the heaviest patterns are stored on the lower floor. Shelving varies as to spacing. Several bays are designed to take matchplate patterns, and the distances between shelves vary from 12 to 20 inches. Wooden dowel pins, projecting through slots on 1½ inch centers, make it possible to store patterns of that type on end. No space is wasted, patterns are easy to get at, and, of more importance, they do not get all battered up.

Reports on Minerals

Production, imports and exports of various minerals are reported in a recent publication of the department of commerce, bureau of mines, entitled "Mineral Resources of the United States, 1929." Part I, consisting of 968 pages, is devoted to metals, both ferrous and nonferrous. Part II gives similar information on nonmetallic mineral products, such as abrasive materials, asbestos, clay, fluorspar, graphite, magnesium, coke, petroleum, etc. Information includes production figures for the various leading producing states of sections and for the country as a whole, world production, value of the product, etc. The report is for sale by the superintendent of document, Washington, for $1.50.

Book Review

Foundrywork and Metallurgy, Vol. II, edited by R. T. Rolfe, imitation leather, 240 pages, 5 x 7¼ inches, published by Isaac Pitman & Sons, London and New York, and supplied by The Foundry, Cleveland, for $1.75 plus 15 cents postage and in Europe by the Penton Publishing Co. Ltd., Caxton House, Westminster, London.

Following Vol. I of this series of textbooks, which is devoted to information on patternmaking, mold and core making and machine molding, Vol. II deals with molding sands, nonferrous metallurgy and ferrous metallurgy.

The section on molding sand, prepared by J. Laing, foundry superintendent, W. H. Allen, Sons & Co., Ltd., Bedford, England, considers the chief characteristics essential in molding sand, such as permeability refractoriness, bond strength, etc., as well as methods of testing, mixtures for several classes of work, equipment for mixing molding sand, loam facing mixtures, sand for nonferrous work and for steel foundries.

Fundamental principles of foundry metallurgy, both in the ferrous and nonferrous fields, are discussed in the remaining two sections of the second volume, and were prepared by R. T. Rolfe. The section entitled nonferrous metallurgy deals with the principles governing the cooling of a pure metal, the whole range of binary alloys, and some more complicated systems. Application of the systems in the manufacture of castings also is discussed. As pointed out by the author, the knowledge thus acquired should enable one to understand the more complicated reactions occurring in the cooling of cast iron and steel. The section on ferrous metallurgy covers that information and also deals with high test cast irons.

Opens Offices

Robins Conveying Belt Co., 15 Park Row, New York, has opened the following branch sales offices: 229 Rockefeller building, Cleveland, O., Robert Wisely, representative; 16170 La Salle boulevard, Detroit, M. S. Lambert, representative; 7146 Dartmouth avenue, St. Louis, H. J. Martini, representative; and 905 Edgewood avenue, Charleston, W. Va., R. U. Jackson, representative.

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serving—States of Indiana, Ohio and Michigan

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Phosphorus in Red Brass

(*Continued from page* 17)

found where there is excess zinc. It may be that contradictory evidence is on record, in which case we might safely assume the presence of traces of oxides of copper on which phosphorus is known to act.

It has been stated that phosphorus will deoxidize oxides of tin and zinc, provided the particle sizes are such that they come into sufficiently close contact in the temperature of the red brass melt. Elsewhere this is denied, and the removal of these oxides by phosphorus is held to be purely mechanical.

Another suggestion has been put forward that oxides of tin and zinc are removed by formation of a fluid phosphate slag. The same authority, after observing but little volatilization of phosphorus in the absence of oxygen, reasons that surface oxidation of the molten stream is inhibited, not by an evolution of phosphorus forming a protective envelop, as has been suggested, but that the oxidation products which are of the molten phosphate type furnish the protection.

Rolls Up During Pouring

As an additional point in connection with the oxide skin formed during pouring, we may consider the case of the oxide film on aluminum bronzes which may become folded into or rolled up in the metal during casting, unless pouring, gating and sand conditions are such as to admit the metal with a minimum of disturbance. It is this same aluminum-oxide film on aluminum-contaminated red brass that, during pouring, rolls up to form the inclusions which cause the excessive leak loss in such cases.

It is fairly certain and capable of visible proof that, during pouring, presence of phosphorus prevents formation of an oxide film on the stream of metal. This property is of special interest in the present discussion, since the forthcoming practical tests deal with oxide inclusions that caused leakers. Whether it is felt that such inclusions are formed during pouring the mold or that the oxides are present prior to pouring, charged into the furnace or formed there, both suppositions doubtless are partially correct and the fact still remains phosphorus is beneficial in either event.

The program to be described was undertaken to determine the underlying cause of excessive leak losses which resulted from the presence of greenish-colored inclusions in thin sections of valve castings. As it was anywhere from 2 to 6 weeks or more between the pouring of the castings and their arrival at the test benches, it was extremely desirable to have some means by which the leak-loss information could be obtained immediately.

A foundry floor was set up and a multiple pattern of a small competition globe-valve body, with sections of such thinness that test losses were above the average, was selected to be the basis for all tests. Castings were poured, cleaned, ground and tested in a very short time as will be described.

A Deoxidizier

EXCESSIVE leak losses resulting from the presence of greenish-colored inclusions in thin sections of valve castings led to the experiments described in this article. The study indicates that phosphorus in red brass actually serves as a deoxidizer in addition to making the metal fluid and protecting the stream of molten metal during pouring. The conclusion also is reached that copper in new metal heats is the principal source of oxygen when the melting is under reducing conditions and either remelting or an addition of phosphorus is necessary to remove the oxides and produce solid castings free from inclusions. The article is from a paper presented at the recent Detroit meeting of the American Foundrymen's association.

Usually ten molds (120 castings) were poured from experimentally melted metal, and to avoid misleading test information, a system of handling was employed so that it would be possible to determine at all times the mold (in order of pouring) from which a given casting came, as well as the position of the casting in the mold relative to the runner and sprue. The effect on leak loss of defective molds or faulty pouring of molds thus was a known quantity.

Valve castings, with the center and pipe ends ground smooth, were tested in the rough by clamping a rubber-faced disk over the center end; the leakers were examined carefully to insure that shrinks or porous metal were not responsible. A large lot of rough castings which had passed the pressure test, ultimately was sent through the regular channels to prove that bright dipping, reduction of wall thickness and removal of outer skin by machining were of no practical importance. Leak loss on the lot was 0.27 per cent, half of which was due to castings cracked during machining.

Starting with a capacity heat of all new metals in a small indirect-arc furnace, ten molds of castings were poured without phosphorus additions and the remainder of the heat poured into pigs. Gates, sprues and pigs were then remelted in the same furnace and again ten molds were cast without a phosphorus addition.

This procedure was continued until, at the end of the fifth remelt, there was insufficient metal for another lot. The metal all was sluggish, although less so after the fifth remelt; and the foundry scrap, although varying somewhat, was normal throughout the five lots.

Percentages good on the pressure test for the five groups of castings were, in order, 52.3, 70.0, 95.8, 95.8 and 97.7 per cent. Fractures through defects showed oxide inclusions in all cases.

It thus was demonstrated that, by subjecting prime metals continuously to the reducing atmosphere which characterizes that type of melting equipment, the metal could be deoxidized almost to the point of being satisfactory without phosphorus additions.

Bring About Deoxidization

It was felt that conclusive proof was obtained that phosphorus does more than merely protect the molten stream during pouring, and that phosphorus additions bring about actual deoxidation in the furnace or ladle.

New metal heats to which 0.1 per cent of phosphor copper (15 per cent phosphorus) was added gave better result (with 99 per cent of the castings good on the test) than those with 0.05 per cent (which showed 94.5 per cent good). In a production way the latter amount was ample, since a charge usually is about half remelted material. Fluid metal was obtained in either case and the residual phosphorus was a few thousandths of one per cent.

A heat composed entirely of scrap castings which were leakers was melted in the arc furnace and 0.1 per cent of phosphor copper added. The castings from the heat were 99 per cent good on the test, the foundry loss was 4 per cent, and the residual phosphorus was 0.004 per cent. Remelted leakers, with 25 per cent new metals and without a phosphorus addition, produced castings having an identical foundry loss but which were only 46 per cent good on the test.

This is further evidence that heats containing new metal, either wholly or in part, need to be deoxidized with phosphorus to produce satisfactory results. The copper ingot, which is poled only to a flat set

and contains approximately 0.04 per cent oxygen in typical American wire bar, doubtless is the principal source of the oxygen in prime metal heats.

Starting with an all-new-metal heat, and adding 0.1 per cent of phosphor copper to the first ladle, 0.15 per cent to the second and 0.2 per cent to the third, gave castings which were 99 per cent good on the test. Foundry losses, due to dirt, were normal in all three instances. The residual phosphorus was 0.01 per cent in the two latter cases.

However, when 0.2 per cent of phosphor copper was added each time and continuous remelting practiced, as in the first test mentioned, metal was produced on the fourth remelt which had no desire to remain in the ladle. The residual phosphorus at this point was 0.022 per cent and the metal was, wild (very smoky, and active in the ladle, as if the ladle were wet).

Dirt Loss High

The metal attacked the ladle lining, boiling up dirt which could not be prevented from entering the mold. Exclusive, of this poured in dirt, which left visible holes in the casting, the leak losses were quite low; but the dirt loss in the foundry mounted with each remelt to 47 per cent at the point of maximum wildness.

Reducing the pouring temperature 100 degrees Fahr., from 2100 degrees, after a fifth and final remelt, tamed the metal to normal. Castings were 100 per cent good on the test and 99 per cent good from the standpoint of dirt, although there were a few misruns and cold shuts.

The induction melting unit lends itself nicely to additions of phosphorus in the furnace, just before pouring, and in some circles this is considered desirable. If one-tenth pound is to be added to one hundred pounds of metal, half of the amount is charged into the furnace perhaps 5 minutes before pouring, and the balance is added to the ladles.

It was found, as has been stated previously, that phosphorus is eliminated rather rapidly from the metal at pouring temperature. With 0.006 per cent in the button (the metal left from the previous heat), 0.004 per cent was present after the heat was all molten; and, although 0.1 per cent of the phosphor copper was added prior to pouring, only 0.003 per cent remained as residual phosphorus in the castings.

Leak loss was found to be proportional to the length of time that the phosphorus addition remained in the furnace before pouring. With 0.1 per cent added, the castings from a ladle poured 5 minutes later were 100 per cent good on the test, whereas, when the elapsed time was 10 to 15 minutes, only 89 to 97 per cent good castings were obtained.

The evidence would indicate that phosphorus in red brass actually serves as a deoxidizer, in addition to making the metal fluid and protecting the molten stream during pouring. Various theories are presented as to the mechanics of this deoxidation.

Copper, in new metal heats, is the principal source of oxygen when the melting is under reducing conditions, and either remelting or an addition of phosphorus is necessary to remove the oxides and produce sound castings free from inclusions.

For the alloy in question, which nominally contains 8.5 per cent zinc, the amounts of phosphor copper required are on the order of 0.05 to 0.1 per cent. Since the phosphorus is lost rather rapidly when the metal is at pouring temperature, the residual phosphorus resulting from this practice varies from 0 to 0.007 per cent.

In the arc furnace, when 0.2 per cent of phosphor copper is used continuously, the metal eventually becomes wild and the foundry losses may go as high as 47 per cent dirt. The residual phosphorus at this point is in excess of 0.02 per cent.

Aluminum Castings In New Diesel Engines

(*Concluded from page* 23)

the mold or outside part in core sand and drying it for rigidity.

The castings were poured from No. 355-T5 alloy, an aluminum alloy containing 5 per cent silicon, and subsequently heat treated. The metal poured from two pots, entered the mold through two sprues on top at opposite ends. Large risers were scattered in profusion over the top to supply feeding metal to the shrinking casting. The casting was poured with the cylinder chambers at an angle to the horizontal, rather than at an angle to the vertical as they appear in Fig. 1, and with the joint side of the casting up, that is the side which is later bolted to the companion half.

After the castings were cleaned and critically inspected, they were subjected to pressure tests to insure satisfactory resistance to air, gas and water. Each chamber was tested individually with air or water at a pressure of 60 to 90 pounds per square inch.

Is Vice President

B. F. Miller, author of the article "Refining Methods for Gray Iron" which appears on page 22 of the July issue of THE FOUNDRY is vice president, Rasmussen & Co., engineers, 612 North Michigan avenue, Chicago. This information inadvertently was omitted from the article.

Dedicates Foundry Institute in Germany

Representatives of all associations related to the foundry industry in Germany, leading men in the industry and foreign representatives were present at the dedication of the new Foundry institute at Aachen, Germany recently. Representatives of the states and industry were greeted after the opening of the ceremony by Professor Hoff, vice president of the university. Among the foreign guests, he extended a hearty welcome to J. G. Pearce, British Cast Iron Research association, Birmingham, England.

After honoring Dr. A. Wirtz and thanking him for his work in making the institute possible, Professor Dr. E. Piwowarsky presented a lecture on "Study and Research in the Foundry Institute Aachen" in which he surveyed the education of the students and post-graduates and the results of research accomplished in the past 4 years. Dr. H. Nipper was the second speaker. He presented his impressions of the American Foundry industry and the research work connected with it, gained through his recent visit in America. After the lecture, the new laboratories and melting hall were visited and the first heat was taken from an oil fired cupola of newest construction.

The Foundry institute has an area of approximately 5600 square feet with laboratories for metallurgical and physical research, X-ray equipment, laboratory melting furnaces, equipment for gas and oxygen determinations, chemical and corrosion laboratories. The melting hall is approximately 90 feet long and 60 feet wide and is equipped with various types of melting equipment as well as practically all modern devices needed for molding, core and patternmaking. A complete machine shop is connected with the molding department and an exhibition hall for castings, displaying good and bad methods of molding and a valuable pattern exhibition, are included. The exhibit becomes the property of the University of Aachen after the exhibition in Dusseldorf in 1929.

The institute was originated to provide a means for teaching students theory and practice at the same time. Generous contributions in a time when Germany is short on finances is proof of the importance the industry places on such education.

H. V. Schiefer, formerly with R. H. Beaumont Co., has become associated with C. O. Bartlett & Snow Co., Cleveland, on the sale of fuel and ash handling equipment and bulk material handling systems. Mr. Schiefer will make his headquarters in Cleveland.

Fire Furnace with Powdered Coal

(*Concluded from page* 19)

6 cents a ton. When the furnace hopper is filled a screw feeder attached to the bottom of the hopper feeds coal at the desired rate, positively controlled for combustion by a variable-speed transmission. As pulverized coal enters the exhauster it is picked up by the air stream and delivered to the burner. Here the air and coal, in proper proportions, are mixed thoroughly and blown into

Fig. 4—Coal screenings are stored in this 700-ton concrete silo

the furnace. Valves are provided that give close adjustment of air and permit close control of combustion. This completes the cycle of operation.

Only a small amount of ash is formed when burning pulverized coal. In the case of the melting furnaces, this passes off with the slag and other refuse; in the boilers it is deposited on the bottom of the furnace and must be removed occasionally the same as with hand firing, but not as frequently.

Melting furnaces are equipped with stream line burners, which give a low velocity flame required for metallurgical melting. Annealing ovens are equipped with high-low velocity burners, which give a flame of variable length—a short flame for starting and a long flame for bringing up the front of the oven and holding an even temperature. Each of the three 20-ton ovens has one burner; the ten 35-ton ovens are equipped with two burners each.

Aside from convenience of automatic closely controlled operation, this system is making definite savings in both labor and materials. On the annealing ovens, for instance, several hours have been cut off the cycle of operation. The temperature throughout the entire oven is uniform and castings can be placed in any part of the oven regardless of size, and are annealed thoroughly.

A marked saving of fuel cost is achieved. Formerly, with hand firing, these same ovens required 752 pounds of fuel per ton of castings annealed. With pulverized coal, the consumption is about 500 pounds per ton.

A number of economies have been effected on the melting furnaces. The elimination of hand firemen is a large item. A higher percentage of good castings and more uniform analysis of iron are important results. Hot fluid iron is obtained, 2700 degrees Fahr. and above, at the spout. Ninety per cent of the heats so far have come out minus or plus five points in carbon. Less oxidation and less wear on the furnace lining are other items; also a better ratio of coal to iron.

The system was installed by the Whiting Corp., Harvey, Ill.

Gives Production of Steel Castings in 1931

Production of steel castings in the United States during 1931 totaled 516,579 tons, the lowest output for a number of years. Production was divided into 143,465 tons of basic open-hearth, 184,780 tons of acid open-hearth, or a total of 328,245 tons for the open-hearth processes, 121,052 tons of bessemer, 716 tons of crucible steel and 176,566 tons of electric furnace metal. This information is contained in a recent statistical bulletin of the American Iron & Steel institute, New York.

The same source reports a total production of cast iron pipe and fittings for 1931 of 1,129,292 tons, divided into 1,051,158 tons of pipe and 78,134 tons of fittings, compared with 1,435,736 tons total in 1930, divided into 1,326,902 tons of pipe and 109,034 tons of fittings.

Book Review

American Society of Heating and Ventilating Engineers' Guide, 1932; imitation leather, 876 pages, 6 x 9 inches, published by the American Society of Heating and Ventilating Engineers and supplied by THE FOUNDRY, Cleveland, for $5.00 plus postage, and in Europe by the Penton Publishing Co., Ltd., 416-17 Caxton House, Westminster, London.

To those interested in any of the many phases of heating and ventilation, this book will prove exceedingly valuable. The first section of the work offers extensive information on significant advancement made in technical research, manufacturing, engineering and contracting practice during the past year. Material on furnaces, sands and natural ventilations, unit heaters, pyrometers, etc., should be of special interest to foundrymen.

The second section of the book consists of a data section on modern equipment, and the third division is a list of the membership of the American Society of Heating and Ventilating Engineers.

R. L. Batteiger & Co., Widener building, Philadelphia, have been appointed sales agents in eastern territory for the Thomasville Stone & Lime Co., York, Pa. Products of this company include blast furnace flux, open-hearth furnace flux, cupola flux, burned lime and limestone for other purposes.

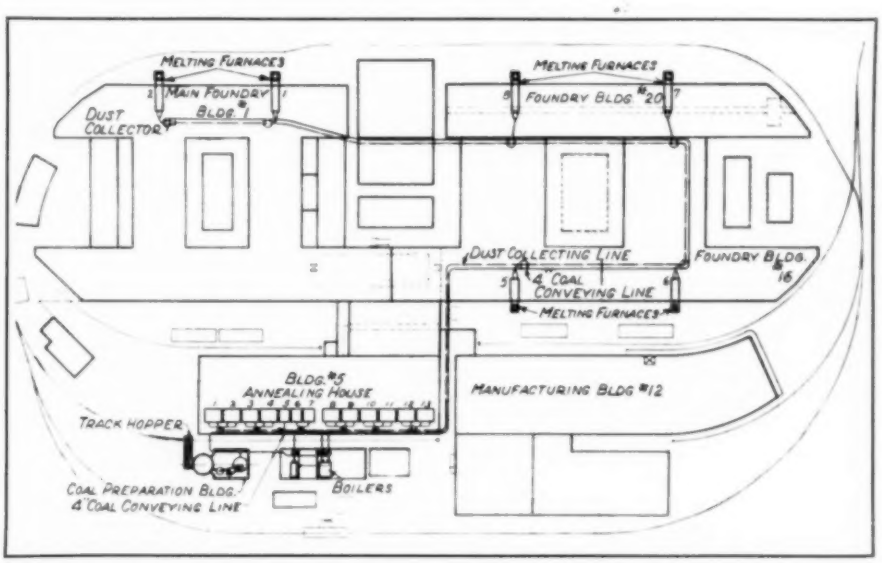

Fig. 5—Layout of malleable plant showing location of the various types of equipment connected with the powdered coal system

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Rocking chair experts discuss causes of aviation

The Adventures of Bill

BY PAT DWYER

LONG after the other members of the party retired, Bill and I remained on the veranda idly rocking to and fro, occasionally relighting blackened pipes and exchanging short detached sentences. The air was hot. Not the fierce sun heat of the day, but a close, enervating species of heat that seemed to suck all the moisture in a person to the surface and cause it to trickle annoyingly over the ledges and among the hills and valleys of one's person. A favorable type of night for doing nothing and—as Bill said—not much of that.

A distant hum that gradually increased to the volume and intensity associated with a roaring plane just after taking off and then a gradual dying away of the sound prompted Bill to wonder who was piloting the plane or what had taken him so far off the usual course of those flying east or west over the city.

"What's the difference," I said, "who he is. Forget him. Perhaps he is an honest citizen driven crazy with the heat and now flying around in spirals like a phillyloo bird trying to keep cool."

"If that's the case I wish I was with him. However, I think you are mistaken. Let us consider this case in the light of pure reason. Let us apply the test of cold logic—"

"On a night like this? This is no little Spanish town!"

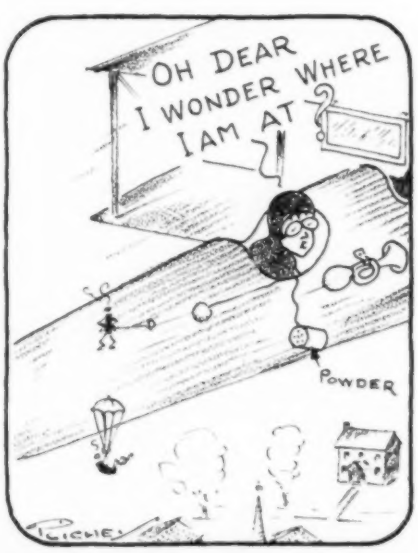
"Well," Bill admitted, "*cold* is not exactly the most appropriate word tonight, but since it was used only in a figurative sense, no great harm has been done. Now let's check off the likely and unlikely factors.

"That plane is not the mail plane unless—an extremely unlikely contingency—the driver is an hour ahead of his schedule and about 3 miles north of the line leading to the airport. By the sound of his engines he is flying too low either for his own safety or for that of those immediately in or under his path. This would seem to indicate that he has lost control, or, is just flying around blind without knowing exactly where he is or whether he is going or coming like a June bug. You know these humming, fuzzy things always bumping into something. I have heard of no cross country races recently and I can't think of any reason why a private individual should take to the air at night—as you say—like a phillyloo bird.

"The indications all point one way. Tomorrow we shall be awakened by news boys crying 'Aviatrix Lands Safely on Pike's Peak!' If your curiosity nerve still is alive you will buy a paper and learn that the intrepid air woman Nancy Hightop hopped off from Chicago to establish a nonstop flight record to Baton Rouge, La., but through one reason or another—mostly another—the machine headed west instead of south and if Pike's Peak had not barred her path she probably would have landed in the Pacific."

"What do you mean, the machine headed west instead of south? Couldn't the lady steer the thing?"

"Apparently not. I never actually have witnessed one of these lady long distance flyers in action and therefore it is possible that the conclusions I have drawn from the published reports of the flights may be all wrong. So long as she is accompanied by a pilot, a navigator and a mechanic she gets along all right and usually attains her objective. These lads take a look at the compass occasionally, and if necessary change the course of the ship to correspond with the chart. They keep their eyes open and note all the variations that affect their flight and make the necessary adjustments.



Road signs lose visibility at high altitudes

"As I said, I may be mistaken, but the published results of many flights have forced the impression on me, that the lady flyer at the outset points the nose of her ship toward her distant and out of sight objective. Then she takes off and just continues to follow her nose.

"Even the best of noses is of little assistance on a dark night. Shut your eyes and I bet you can't walk across the street and come within 10 feet of any point you pick out in advance."

"No," I said, "for the simple reason that if I attempted to step off the curb with my eyes closed I would be hit by an automobile and carried half a mile, or at least as far as the light at the next street intersection if it happened to turn red before the driver arrived. However, what has my ability—or lack of ability—to cross the street got to do with the ladies who fly hither and yon in air ships?"

"Nothing," Bill admitted, "I just used the illustration as a parable or something to show you what happens to a person who depends on a hunch instead of skill, experience and a knowledge of navigation.

"'Le's see,' she says to herself, 'I haven't seen my name in the paper since I got that new flying suit. What's to be done? I think I'll just take a spin in the old crate. On second thought I should prefer a new one.'

"A new plane finished in her favorite colors is purchased. Bulletins are sent to the U. P. and the A. P. announcing that she is all poised for flight and ready to go. Up she goes and disappears until her gas supply is exhausted. Then she comes down where no person ever expected to see her and in a place which cer-

tainly was not in her mind when she started on the journey.

"'Where am I?' she inquires of the first native who appears on the scene. 'Five hundred miles north of where I took off? Isn't that just too funny for words. I was flying south all the time!'

"Talking about airships reminds me of an inquiry I had recently from a man who had made six diesel engine pistons and only salvaged two out of the six. By a curious coincidence he had used a slightly different mixture in the two good pistons and he was wondering if that factor was responsible. Long, practical experience warned him that probably some other factor was present. Other orders were in prospect and he was seeking information before he tackled the job.

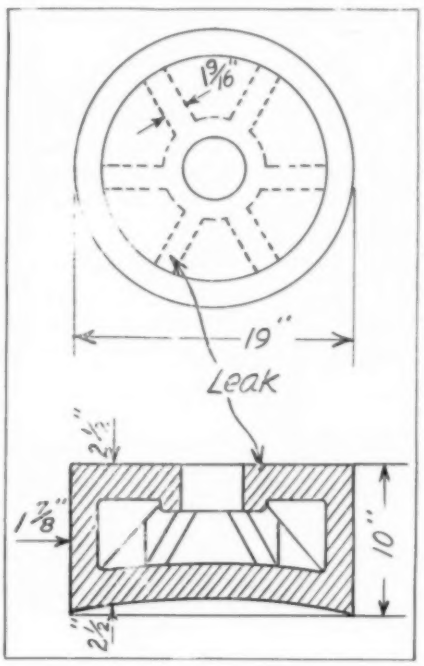
"He wrote that the castings 10 inches high and 19 inches in diameter, machined up clean but they leaked through the web above the brackets when subjected to a water pressure of 100 pounds per square inch and you know that is not a severe test. The chamber core all in one piece is divided by six brackets. It is suspended from the cope and held in place by double end chaplets between the upper side and the face of the cope where standards rammed in the sand afford the necessary rigidity. The casting is fed by hot metal caught in hand ladles direct from the cupola and poured down four large risers on the rim of the casting.

"The cupola charge is made up of 600 pounds pig iron, 300 pounds machinery scrap and 300 pounds steel boiler plate clippings. Analysis of the pig iron follows: Silicon 1.85 per cent; sulphur 0.05 per cent; phosphorus 0.30 per cent; manganese 0.90 per cent; combined carbon 0.48 per cent; graphitic carbon 3.10 per cent.

"In cores for future castings he is thinking of using a one-piece cast iron arbor and thus dispensing with the chaplets. He also is considering the use of chills along side the outer end of the brackets in the cores. He ended by writing that he would appreciate my opinion on the probable cause of the leaks and any remedy I might propose to prevent their appearance in future.

"To really form a satisfactory opinion in a case of that kind I should like to see the casting broken under a drop ball. The condition of the metal in the leaky area might furnish a valuable clew. Leaks may be due to one or two or even a combination of causes and in some instances these causes are extremely obscure. In other instances the cause is self revealing. Evidently in the present instance the evidence was cloudy.

"The anticipated analysis from the mixture given would show a silicon content of approximately 1.50 per cent and with the other elements showing practically no or little change. This composition—even with slight variations—is quite satisfactory for castings of the type outlined. The iron mixture is not responsible for the leaky structure. Presumably the iron was melted satisfactorily since the castings machined up clean. The core may be responsible, at least in part. Unless the vent gets away with greater than usual freedom, it will cause the metal to flutter over



Plan and sectional view of cracked diesel piston

the brackets. In some instances this fluttering will cease before the metal solidifies, but in the majority of instances this fluttering will cause the metal in the vicinity to set rapidly, to hold some of the gas and thus produce a defective area. The core is surrounded almost entirely by molten iron, and in addition presents six deep brackets which intensify the generation of gas.

"However, the position of the casting and the method by which it is gated are the principal factors responsible for the leaky structure. Theoretically, to insure a solid casting, the metal should commence to freeze at the bottom. This freezing action should work up gradually to the top so that feeding constantly could continue by gravity from hot metal in the gates or feeding heads. In this instance the thickest part of the castings is on the bottom, where it remains liquid after the top part has solidified.

"The entire mold is filled with hot metal introduced through a gate at the bottom. Thus the ideal theoretical condition is reversed since the hottest metal is at the bottom when solidification commences. The plate at the top solidifies before the plate at the bottom. Some of the metal to feed the bottom is drawn through the brackets and as a result the metal above the brackets is robbed to a certain extent. It is not as dense and homogenous as it should be.

The obvious remedy is to mold the casting in the opposite position and pour the metal through half a dozen ½-inch pop gates spaced about 3 inches apart on top of the rim. Molded and poured in this manner, the lower part of the casting will solidify first and therefore will not draw metal from the upper part later. The upper part may be fed by three of the present type risers. This method of molding also will dispense with the chaplets since the core will rest on the center print in the drag and will be bolted to the bottom plate. Naturally a solid bearing will be required for the core print and suitable precaution must be taken to prevent any metal from seeping down around the print. The core must be made from an open grade of sand, bonded with a minimum amount of binder, thoroughly dried and provided with ample vent opening."

Engineers Nominate

American Society of Mechanical Engineers, New York, has nominated officers for 1933 as follows: President, A. A. Potter, dean, school of engineering, Purdue university, Lafayette, Ind.; vice presidents, H. V. Coes, consulting management engineer, Ford Bacon & Davis, Inc., New York, James D. Cunningham, president, Republic Flow Meters Corp., Chicago, C. F. Hirshfield, chief of research department, Detroit Edison Co., Detroit; managers, R. L. Sackett, dean of engineering, Pennsylvania State college, State College, Pa., Alexander D. Bailey, superintendent generating stations, Commonwealth Edison Co., Chicago, and John A. Hunter, professor of mechanical engineering, University of Colorado, Boulder, Colo.

Antimony in Bronze

"Effect of Antimony on the Mechanical Properties of a Bearing Bronze," by C. E. Eggenschwiler, recently has been published by the U. S. department of commerce, bureau of standards, as research paper No. 442. The article is a reprint from the bureau of standard's *Journal of Research*, Volume 8, May, 1932. The bulletin is for sale by the superintendent of documents, Washington.

John E. Livingstone Co., 2-246 General Motors building, Detroit, has been appointed sales agent for the hoist and crane division, Robbins & Myers Sales Inc., Springfield, O., in the Detroit territory.

New Canadian Foundry Is Modern

Jenkins Bros. Ltd. builds new bronze and iron shop at Lachine to meet demand for products

EARLY in April, Jenkins Bros. Ltd. formally opened a new bronze and iron foundry at Lachine, P. Q., Canada. The company held open house and the many visitors were shown over the new foundries, and the new power house which were in full operation. The opening ceremonies were conducted by Farnham Yardley, president of the company, who presented the golden key to James H. Webb, vice president and managing director. Other company officials present were C. V. Barrington, vice president; A. Eugene Brady, treasurer; A. G. Stewart, secretary; J. S. Mock, director of sales; Herbert H. Gee, Ontario manager of sales and director; John D. Stiles, former director and first Canadian salesman; and J. R. White, Jenkins Bros., New York.

Following the formal opening, a luncheon was served and handsome souvenior ash trays, made in the new foundry, were distributed. Among the distinguished guests present were the Mayors of Lachine and Montreal West, George Ross and R. H. Macdonald, Walter J. Armstrong, James Ballantyne, Dr. F. G. Pedley, McGill university, F. C. E. Burnett, Birmingham, England, Col. H. A. Stewart, A. F. Byers, H. J. Roast, N. H. Henderson, G. E. Templeton, Edward Darling, and many others.

The business, now known as Jenkins Bros., began in 1864 when Nathaniel Jenkins became interested in the invention and production of water faucets and opened a place of business at 52 Sudbury street, Boston. He conceived the idea of having faucets fitted with renewable packings and after considerable research developed a rubber compound that would stand both hot water and steam. In time other inventions were made and the company grew and extended its activities to include the manufacture of iron body as well as bronze valves. Growth of the export business led the company to erect a plant in Canada, and 1906-07, Jenkins Bros. Ltd. was incorporated.

Built on the firm foundation of quality and reliability, Jenkins Bros. Ltd. has expanded and developed to such an extent that the new plant was necessary. It is a mark of distinct courage on the part of the company to plan and complete the new foundry and the power house at a time when little industrial expansion is under way.

New foundries, and the power house are located on a large tract of land in the city of Lachine, on the Canadian National railways, from which a siding runs directly to the new building. The site eventually will accommodate the entire plant of Jenkins Bros. Ltd. The bronze and iron foundry building is approximately 244 feet wide with an average depth of 255 feet, and is one story in height.

Secure Light and Ventilation

Since light, heat and ventilation are most essential for the comfort and efficiency of those working in the foundry, special attention was paid to those factors in designing and constructing the building. In addition to the side wall windows, which are of steel sash, large roof monitors provide ample light without using artificial lighting. Monitors are arranged to provide excellent ventilation. In addition to regular radiators which are placed throughout the building, unit heaters have been provided in vital places, so that when the weather is exceedingly cold, the unit heaters can be placed in use.

In planning the arrangement of the building and equipment, its purpose has been the guiding thought, and the principles adopted are based upon orderly methods of operation and the application and use of the latest and most improved practices of manufacture and equipment.

The heavy iron foundry is in the west section of the building, parallel with the railway siding and supplied with a 50-ton, 40-foot span craneway, running the full length. Bins for scrap, pig iron and sand are located along the west side of the building with receiving doors opening from the railroad siding. The cupolas are located between the metal bins and heavy iron foundry. The light iron foundry has been placed in the center of the building adjacent to the heavy iron shop. The core room is on the north side of the building, next to the foundry.

The bronze foundry is situated in the east section of the building and is separated from the iron foundry

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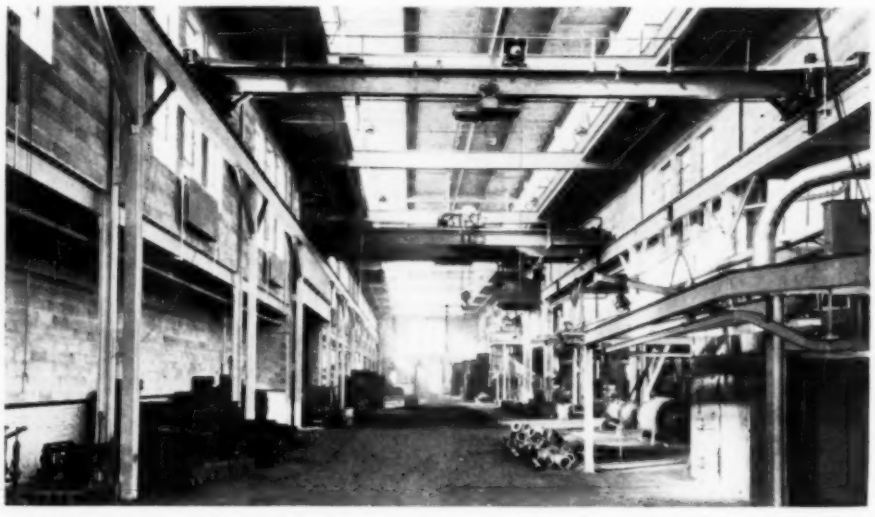
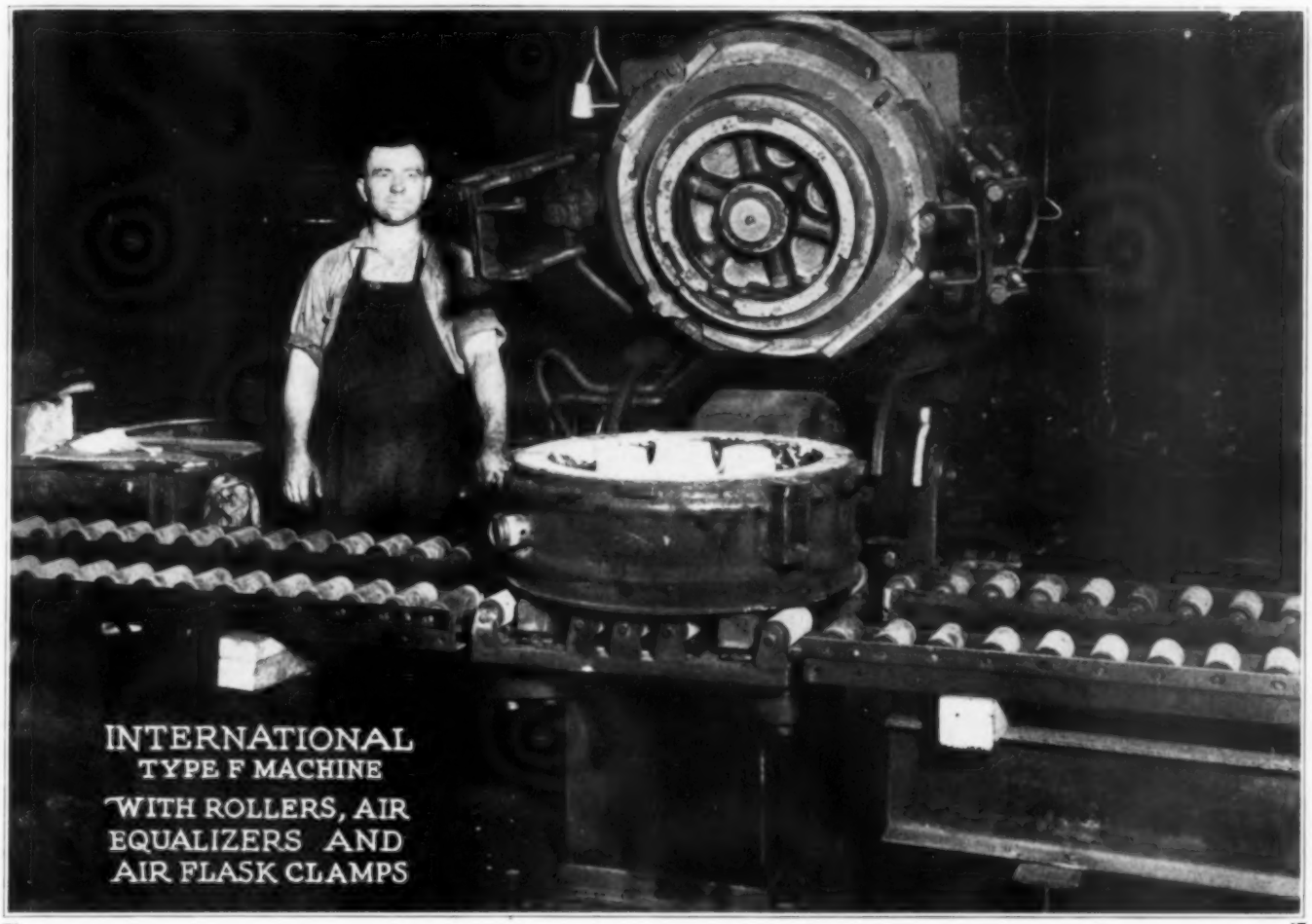


Sandblast and tumbling barrels are located on the right, and the molding and melting department for iron in the background



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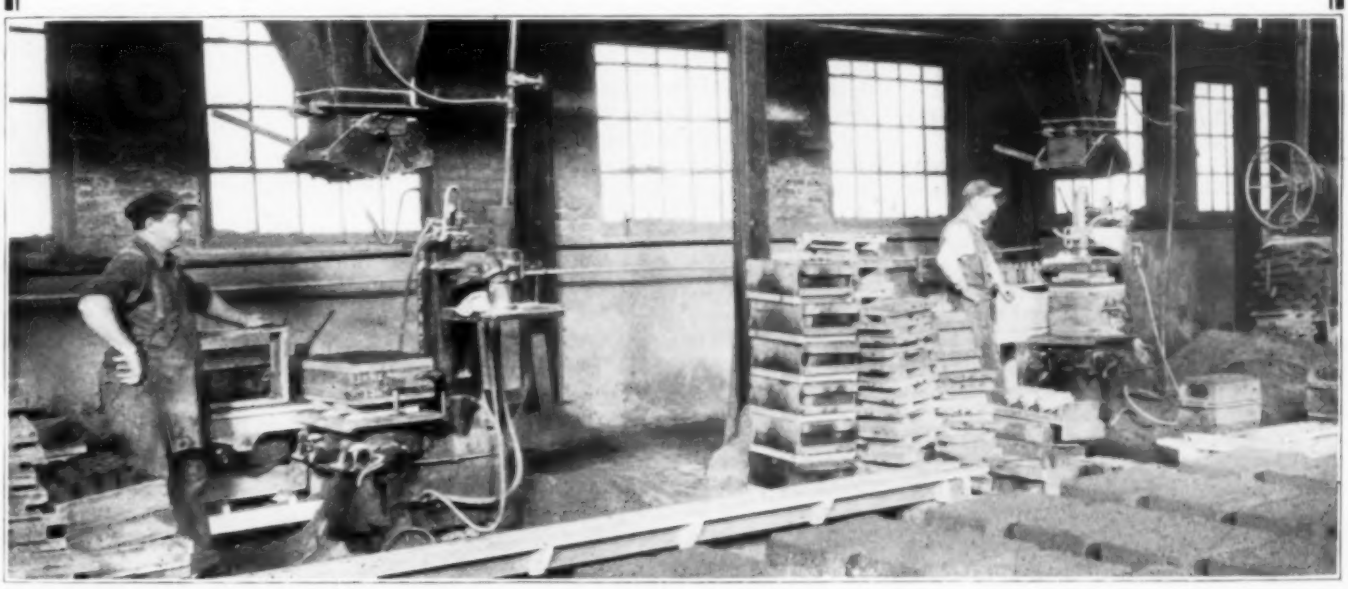

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by a brick wall division. Two bronze shop core rooms are provided on the north end of the building and the general pattern storage vault is located along the east side. Bronze metal storage is on the southeast corner arranged with bins for the different types of metals and the furnaces for melting the bronze are located adjacent to the storage.

A tunnel has been built along the north, east and south side of the building and all piping for air, oil and gas is carried through that tunnel, so that it will not interfere in any with the operation of the plant. At the same time all of the piping is accessible through conveniently located manholes. Each line of piping is distinctly marked to indicate whether it is for steam, gas, oil or air. The boiler and power house, which is located in a separate building, is planned to take care of the needs of the entire plant as now planned, although at present only a portion of that equipment has been installed. The boiler and power house also accommodate the electric light and power transformer and switchboard equipment.

Electric furnace installations consist of a 150 kilovolt ampere furnace operating at approximately 90 volts. Provision has been made for two additional furnaces of the same capacity. Artificial lighting throughout the plant has been designed to give adquate lumination for various classes of work and the average intensity is on the order of 10-foot candles. A flexible arrangement of circuit control is available, which permits lighting of only such parts of the foundry as are in actual use.

Contracts for the erection of the bronze and iron foundries and the power house were awarded to A. F. Byers & Co. Ltd., Jas. Ballantyne, P. McCuaig Ltd., Grinnell Co. of Canada Ltd. Plans and specifications were drawn up by Ross and Macdonald, architects, Montreal, with the assistance of W. J. Armstrong, Montreal, consulting engineer and Edwin S. Carman, Cleveland.

Forms Supply Equipment

Included in the firms supplying materials and equipment for the work were the following: Detroit Electric Furnace Co.; Jeffrey Mfg. Co. Ltd.; Canadian General Electric Co.; Foundry Equipment Co. Ltd.; W. W. Sly Mfg. Co. Ltd.; Richards-Wilcox Canadian Co. Ltd.; Mathews Conveyor Co. Ltd.; Dominion Bridge Co. Ltd.; Babcock-Wilcox & Goldie-McCulloch Ltd.; Rudel-Ryder Machinery Co. Ltd.; Gurney Scale Co. Ltd.; Canadian Ingersoll-Rand Co. Ltd.; Canadian Westinghouse Co. Ltd.; English Electric Co. Ltd.; Canada Cement Co. Ltd.; Cooksville Brick Co.; National Brick Co. Ltd.; Pilkington Bros. (Can.) Ltd.; Steel Co. of Canada Ltd.; Alexander Murray & Co. Ltd.; Eastern Steel Products Ltd.; Geo. W. Reed & Co. Ltd.; Taylor Forbes Co. Ltd.; Canada Wire & Cable Co.; Northern Electric Co. Ltd.; Aerocrete Construction Co. Reg'd.; Francis Hankin & Co. Ltd.; Canadian Metal Window & Steel Products Ltd.; Jas. Robertson Co. Ltd.; C. A. Dunham Co. Ltd.; and Frigidaire Corp.

Proper Care Must Be Exercised In the Selection of Truck Drivers

GRANTED that it is important in any business using motor trucks to see that they are properly handled, what is the best procedure to accomplish it? Naturally any program to be effective must begin with the right material. Nothing can be said in defense of the cut-and-try plan of hiring indiscriminately with the thought that the unfit can be fired. There is no economy in selecting drivers by experiment. The damage they may do during a probation period may exceed many times the most it possibly can cost to study and examine the men before they are taken on, even on trial. A far better policy is to choose men with such care that the permanence of their employment reasonably is assured.

Having a set policy in hiring help is not likely to be advisable, especially if it goes to either extreme of hiring only young and raw material for training, or none but experienced help needing little additional training. Probably the most economical is a middle course and the size of the organization will determine largely which way it should lean.

Usually there are or should be at least three things done in selecting drivers, in the following order: Examine prospect's written application, interview him and consult his references. An attempt to dispense with any one is unwise even though he is only hired on trial. However carefully he is picked he should be on probation for a month at least.

Application blanks need not be printed if not used frequently but at least they should be typed so that they always include a standard set of questions—and no more than are really necessary. The application form should be confined principally to asking such facts as pertain to training and experience.

Each company is the best judge as to what its application form should contain, but by way of suggestion it may be helpful to notice what the Metropolitan Group of Commercial Vehicle Operators, which meets under the auspices of the New York office of the National Safety council, recently discussed as the items of information that should be considered. They were as follows:

1. Personal
   - a—Name
   - b—Address
   - c—Period lived at address
   - d—Telephone
   - e—Date of birth
   - f—Family: parents: wife: children
   - g—Dependents
   - h—Schooling
2. Condition
   - a—General health
   - b—Hearing
   - c—Sight
   - d—Speech impediment
   - e—Physical deformities
   - f—Recent illnesses or operations
3. Responsibility
   - a—Life insurance
   - b—Real property
   - c—Automobile
   - d—Ability to bond
   - e—Debts
4. Experience
   - a—Chauffeurs license since:
   - b—Present license number
   - c—How long driving
   - d—Type of vehicles operated
   - e—Type of work done
   - f—Convictions for traffic violations
   - g—Revocations or suspensions of license
   - h—Previous accidents
   - i—Previous employers: Name, addresses, dates.

A study of the application will serve to weed out some of the unsuitable applicants.

The interviewer always should be a good judge of human nature. He will eliminate most of the remaining undesirables and save lots of time. Nevertheless, consulting references should not be omitted concerning really likely prospects for it will reduce the amount of experimenting in trying out new men. At least the last employer should always be consulted if possible. It may mean a great deal to know why he left his last position and his statement as to that should always be checked.

Again quoting from deliberations of the Commercial Vehicle Operators the following is an outline suggested for the personal interview investigation:

1. Physical condition
   - A—Appearance
     - 1—General color
     - 2—Cleanliness
     - 3—Alertness
     - 4—Nervousness (natural or otherwise)
2. Deformities (visible to interviewer)
   - 1—Vision. Example: undue squint or stare.
   - 2—Hearing. Example: strain in hearing interviewer.

3—Loss of or restriction in use of extremities.
4—Physical, or systematic nervousness. Example: twitch.

Such deformities as these may be so visible and apparent that they would at once preclude the possibility of using the applicant as a motor vehicle operator.

3. Physique
   1—Robust
   2—Sturdy
   3—Weak
4. Past experience
   1—Narration by prospective driver of previous accidents
   2—Questioned by interviewer as to driver's opinion of cause; personal attitude; damage involved; actions he would take in similar future cases; etc.

Sometimes it is desirable to have more than one in the organization interview a prospect. For example, the garage superintendent may examine him for his knowledge of the equipment he will handle, the transportation or traffic manager will find out what he knows of roads and districts, or a department foreman will see how familiar he is with the requirements of the particular business.

A copy of safe practice pamphlet D-2 entitled "Selecting Drivers for Commercial Vehicles," may be obtained through the National Safety Council, 20 North Wacker Drive, Chicago.

International Congress To Meet in Paris

(*Concluded from Page* 25)

Romancer: "Influence of High Silicon on the Graphitization of Cast-Iron," by A. Le Thomas and M. Olinger; "Contribution to the Study of the Machineability of Cast-Irons," by M. Henon; "Variations of the Deflection in the Static Bending Test of Cast-Irons," by M. Guillemeau; "Welding of Cast-Irons," by M. Granjon; "Hardness Effect of Silicon on Cupro-Nickels Containing Tin and on Bronzes," by Dr. Ballay and A. Le Thomas; "An Example of Rational Organization for Nonreproduction Jobs," by M. Bloch; "Prevention of Accidents in the Foundry," by M. Ageron; "Contribution to the Study of Low-Carbon Cast-Irons," by M. Portier; "Problems Arising From the Preservation and the Development of the Use of Castings," by M. Renaud; Report of the committee on the international dictionary of foundry terms.

Foreign visitors to the Paris congress are offered a varied series of pre and post-convention tours. Starting from Boulogne on Friday, Sept. 9, a conducted tour of Northern France has been arranged. The first day will cover Marquise with a visit to manufacturing establishments and thence by motor coach to Lille by way of Saint-Omer and Hazebrouch. The following day will be spent in the former city where inspection of the plants of Massey-Harris and Fives-Lille companies will occupy the entire day. Sunday in Lille will be given over to museum visits. Monday, the party will leave by motor-coach to visit plants in Denain and Valenciennes and Tuesday will be occupied by plant inspections enroute to Paris for the dinner preceding the Congress on Sept. 13.

A simultaneous tour covering the Normandy country will provide sightseeing trips starting from Havre by way of Rouen, Lisieux Caen and Deauville to terminate in Paris, Tuesday, Sept. 13. Plant inspection is provided at Havre, Lisieux, Caen and intervening points.

Three post-Convention tours are offered. The first is a trip through the mid-section of France and to the Alps. This party will leave Paris, Monday, Sept. 19 by train, arriving at Blois in the afternoon to visit the castles of Bloise and Amboise. Tuesday morning the men of the party will inspect the P. O. railway company shops while sightseeing tours are provided for the ladies. The entire party will visit the castles Langeais, Azay-le-Rideau, Montbazon, Blere' and Chenonceauz in the afternoon and depart in the evening for Bourges, where the following day will be spent in plant inspection trips for the men and sightseeing will be arranged for the ladies. Thursday will be spent in Lyon and Oullins. A motor coach trip the folowing day will take the party to Chambe'ry, Albertville, Ugine and Annecy. Saturday will cover Ugine and La Montagne de Beaufort, Grenoble and le Echelles. Sunday will be passed at Grenoble and the party will proceed to Nice by way of Guillestre, Barcelonnette and intervening points of interest where the tour will terminate Sept. 26.

A short tour will coincide with the forgoing but will return to Paris from Grenoble Sunday, Sept. 25.

The remaining post-convention tour covers Ardenes and eastern France, starting from Paris Sept. 19. Plant inspection will cover the plants of La Mace'rienne, Gailly, and Deville companies Monday at Charleville-Mezieres Tuesday the trip will cover Fumay, the valley of the Meuse, Tournes, Revin to Rochefort. Monday the party will proceed by motor coach by way of Neufchateau, Aelon and Longway to Luxemburgh where a reception and dinner will be held. Thursday covers from Luxemburgh by way of Villerupt where the Societe Metallurgique Aubruves will be visited and also factories at Bel-Val, Audun-le-Tiche to Nancy. Factory and mine inspection will occupy Friday in Nancy, where the tour ends Saturday, Sept. 24.

Committees have been organized under the capable direction of M. E. Ronceray, president of the Association Technique de Fonderie of France, which have arrangements in charge for the congress and for the tours which precede and follow the Paris activities. Travel arrangements have been assigned to Agence, Lubin, Paris. Overseas members planning to attend the congress will be met at Havre, Dieppe, Boulogne or Calais. The French national railway system has granted a reduction of 42 per cent in fares to cover travel to and from the congress and pre or post-convention tours.

Certify Quality Of Gray Iron Castings

A plan for certifying gray iron castings recently was announced by the Gray Iron institute, Cleveland. Certifications will indicate that the castings conform to the new specifications covering different types of gray iron castings, which recently were adopted by the A. S. T. M.

The certification plan has been an objective of the merchandising program of the institute for several years. Certification of product proposed by Walter L. Seelbach, Forest City Foundries Co., Cleveland, at the annual meeting of the institute in 1929, following the completion of his first year as president of that group. Since that time, numerous individuals in the industry have recommended such a move, but have awaited established and recognized standards as a basis.

The institute has made provisions for setting up shop standards and checking results through the use of transverse test bars. Members will send bars from each heat to the main office of the institute, where they will be checked and the results reported to each member. Periodically, certificates will be issued by the institute showing that the holder has produced iron of given specifications over a definite period.

Issues Directory Of Steel Foundries

The Steel Founders Society of America has issued its directory for 1932-33. This includes all manufacturers of steel castings and heat and corrosion-resistant alloy castings in the United States and Canada. The directory, which is compiled under supervision of Granville P. Rogers, managing director of the Steel Founders society, contains an alphabetical list of firms with names of officials, type and size of castings produced, melting equipment, number of employes and r nthly capacity in tons. An index by states follows and a separate section is devoted to heat and corrosion-resistant alloy foundries.

One-sixth of cuts and lacerations resulting from employe accidents become infected according to the National Safety council.

Rating Squeezer Production

(*Concluded from page* 21)

C—Volume of cope in cubic inches
D—Volume of drag in cubic inches
W—Width of flask in feet
K—Pouring weight
B—Time for Group 3 operations in minutes.

The formula can be simplified further and made easier to use by grouping the factors around *C*, i. e. .00045 (*W*+2.48), and those around *D*, i. e. .00037(*W*+2.82). These groups, which would vary only with the width *W*, can be combined and listed in a small table. The simplified formula, using *X* for the factors around *C*, and *Y* for the factors around *D*, is shown in Table I. Some group 3 values are also given.

Operations Divided

It will be noted that the operation of setting cores, chills, etc., is divided into two parts. The first operation of getting the unit or units from the point of storage near the operator to the position ready to set does not vary effectively with the size or shape of the unit to be set. For that operation a flat rate of 0.10 or 4.2 seconds is applied. The second operation of placing the unit in the mold does vary in time value but can be classified for control. The majority of this work will fall in classes *B* and *C*. For example in using this system, a mold requiring four small cores easy to set would have a Group 3 value of 0.10 for getting the four cores at one time from the box and 0.03 for setting each core or a total of 0.22. If the cores were of such shape or size that the molder could handle only two at a time the value would be (2x0.10)+(4x0.03) or 0.32.

To facilitate checking in practical applications a table of base rates in dollars per hundred was prepared and used. While the value of Group 1 was not varied throughout the table, as were the values of Group 2, the Group 1 value was added in each case to the Group 2 value. In doing this one-half was added to each half mold simply to keep in evidence the difference in Group 2 value of these two parts even though their dimensions are the same.

Table II shows the form of this table and an example of its use. It covers flasks from 8 to 12 inches in width up to 36 inches in length, and from 13 to 20 inches in width up to 30 inches in length, with cope or drag depths and pouring weights as shown. Lateral dimensions vary in steps of 1-inch.

It should be understood clearly that the rates set-up by this formula (which may be changed readily to man-minutes or points) are not claimed to represent what any particular foundry should be doing, or even an average of what is being done. It simply sets up a system of rates which vary with the effective variables on a practical scientific basis. A simple method for determining the adjustment factor is shown in Table III.

It is best to take a total day's work, but where a great number of machines are operated a representative group may be used. Divide the sum of the present rates by the sum of the base rates, found by the formula, to find the percentage factor to use as standard practice with the formula. When found by that method its use will adjust the rates in such a way that the scale or payroll will not be altered. Once this is done the method can be applied, starting either with a revision of present rates or with new work as it comes. The pouring element is in a separate group (0.053*K*) and is based on ferrous metals with the molder pouring his own work. It can be eliminated in any cases where the molder does not pour, or altered in proportion to weight in the comparatively few cases where the molder pours his own work with nonferrous metals.

Method Is Practical

Some base rates set up by the formula, which indicate forcibly that the method, is practical in application will be noted on the first six floors in Table III. It is an accepted fact that of two molds of the same area and depth but of different widths, the wider is more difficult. Floors 1 and 2 show the effectivenesss of the formula in that respect. It also is evident that of two molds having the same lateral dimensions and the same total depth, but with different depths of cope and drag, the one having the deeper cope is slightly more difficult. The operation of the formula under these conditions is shown in Floors 3 and 4. Variations caused by pouring weight is shown on Floors 5 and 6.

This formula has been checked against practice in shops where conditions were excellent for good ratings, and no error on small, medium, or large work was evident. In 7500 tabulations in the table covering such an extensive range, any impractical elements in the formula surely would show up.

To further check, a formula and table to cover this type of molding under the mold-conveyor, continuous-pour method was made by simple transposition in the original basic formula. This new formula was derived from the first by changing *E* to a Group 1 operation on time basis, decreasing *H* in the proper proportion and eliminating *J*. The ratio between floor rates and conveyor rates check very closely with those proven by practice; the economy varying directly as the Group 2 values and inversely as the Group 3 values.

Table III

Base Rates Set Up By Formula

Floor Number	Pattern Number	Flask Size Inches	Cope Depth Inches	Drag Depth Inches	Group 3—Minutes	Pouring Weight	Present Rate	Base Rate (by formula)	Adjusted Rate (9) x 1.10. (see note)	Molds Made For	Molds Made Check	Molds Made Only	Earned Present (8) x (11)	Adjusted Earning (10) x (11)
1	2	3	4	5	6	7	8	9	10	11	12	13		
1	530-20	10x21	4	4	0.0	6	5.00	4.11	4.52	170	8.50	7.70		
2	6848-B	14x15	4	4	0.0	6	5.00	4.35	4.78	160	8.00	7.65		
3	28-930	12x20	3	8	0.0	9	6.00	5.38	5.92	125	7.50	7.40		
4	20-9	12x20	8	3	0.0	9	6.50	5.55	6.11	130	7.80	7.95		
5	48-B-1	13x21	4	3½	0.0	6	5.00	4.86	5.35	150	7.50	8.02		
6	28-631	13x21	4	3½	0.0	12	5.00	5.18	5.70	120	6.00	6.84		
7	1180-A	11x14	4½	3	0.07	8	4.50	3.63	3.99	200	9.00	7.98		
8	1420	11x20	4½	3	0.10	8	5.00	4.40	4.84	150	7.50	7.26		
9	1638-1	10x18	5	4	0.0	6	4.50	4.04	4.44	160	7.20	7.10		
10	4-B-6	14x18	5	4	0.20	6	6.00	5.55	6.10	120	7.20	7.32		
11	88-130	12x20	4	4	0.23	10	5.50	5.13	5.64	110	6.05	6.20		
12	678-A	8x30	3½	2½	0.17	5	5.00	3.88	4.27	180	9.00	7.70		
13	90-10	12x16	3½	6	0.0	9	4.50	4.56	5.02	140	6.30	7.02		
14	48-31	14x14	4	5	0.0	7	5.00	4.50	4.95	155	7.75	7.67		
15	B-600	12x24	4	3½	0.07	10	6.00	5.27	5.80	150	9.00	8.70		
16	52-3	16x16	5	3	0.18	9	6.00	5.53	6.08	130	7.80	7.90		
17	531-78	11x16	3½	4½	0.14	6	4.50	3.96	4.36	150	6.75	6.55		
18	28-900	11x22	4	4	0.10	7	5.00	4.73	5.20	135	6.75	7.02		
19	280-B	10x24	6	3	0.0	10	5.50	5.05	5.58	160	8.80	8.95		
20	33-343	13x18	4	4½	0.0	13	5.00	5.13	5.64	130	6.50	7.32		
					Totals		104.50	94.79	104.29		150.90	150.25		

Note: $\frac{104.50}{94.79}$ equals 1.10, which is the percentage factor used against the base rate to adjust to local conditions. Columns 11, 12, and 13 are shown simply to make clear that while the distribution is altered the total payroll remains the same.

FOREWARNED is FOREARMED

A small change of iron in your castings will guard against defects which cost time and money.

THE buyer of castings knows better than anyone else what trouble-makers defective castings can be. They break down and wear out before their time. They necessitate costly replacements. They detract definitely from the quality of your finished product.

Knowing this from experience, the progressive buyer of castings is forewarned. And he should be forearmed accordingly — especially when it is so easy to insure castings against defects.

A simple sentence of 13 words in your castings specifications will work wonders in this respect. The sentence is: "all castings to contain at least 15% to 20% Superior Charcoal Pig Iron."

With Superior Charcoal Iron in the mix, your castings will be stronger, tougher, denser in structure. They will be more durable, more uniform, easier to machine. And your foundry will have less scrap loss— which saves you money.

Take advantage of this easy way to guard against disaster. When buying castings, insist that they contain a percentage of Superior Charcoal Pig Iron.

SUPERIOR CHARCOAL IRON CO.
Grand Rapids, Mich.
Debevoise-Anderson Co., Inc., *Eastern Representative*
New York - Boston - Philadelphia

READ THIS ADVERTISEMENT!

It belongs to you, foundrymen. It's a sample of the kind of ad we are running in your customers' magazines every month--telling buyers of castings how to make your job easier--and your profits bigger.

YOUR CASTINGS . . . *made with Charcoal Pig Iron have* . . . GREATER DENSITY · ADDED TOUGHNESS · MORE STRENGTH · LESS SCRAP LOSS · GREATER UNIFORMITY · EASIER MACHINABILITY . . . *and you get higher quality finished products*

Superior Charcoal Pig Iron

European Foundry Practice

Digest of recent literature covering various phases of castings manufacture

Copper in Iron

Influence of Copper on Cast Iron. By J. E. Hurst, *The Iron & Steel Industry*, London, June and July, 1932.

Various investigators on that subject have pointed out that copper in cast iron produces a fine polish and the iron hardens like steel; it increases relative fluidity and the fractured surface becomes more coarsely crystalline and brighter as the copper percentages increase; presence of 4.9 per cent copper increases the tensile strength from 19 to 22 tons per square inch, the iron remaining quite gray; increases brinell number slightly and tends to reduce the combined carbon content; lowers the shrinkage value and the depth of chill. The effect of copper appears to be exactly similar to nickel, although not as pronounced.

To study the subject further, the author conducted experiments on cylindrical drums 4 inches in diameter, 8 inches long and 0.375 inches in radial thickness, cast by the centrifugal process. Copper was added in the form of turnings to the molten metal in the ladle. Results show a tendency toward lower combined carbon with higher percentages of copper; the breaking strength is not affected seriously, a slight lowering being shown; the permanent set value practically is unaffected; the modulus of elasticity shows a slight increase; increasing quantities of copper give a slight decrease in hardness; no influence on brittleness is shown. Due to the resemblance between copper and nickel, the behavior of copper in the presence of a third element, namely chromium, was investigated.

At Low Temperatures

Physical Properties of Steel Castings at Low Temperatures. (Festigkeit Seigen Schaften von Stahlgus bei Tiefen Temperaturen) by Richard Walle, Stahl und Eisen, Duesseldorf, Germany, May 19.

Cast steel frequently has been investigated as to its strength properties at high temperatures, but little data is available as to its mechanical properties at low temperatures.

Specimens of cast steel of two different compositions were tested for tensile strength, yield point, elongation, hardness and notch toughness, at temperatures ranging from plus 20 down to minus 77 degrees Cent.

Curves were plotted showing changes in properties of the two cast steels, as a function of temperature. Tensile strength increased linearly with decreasing temperature, as also did yield limit and hardness. Elongation tests with the one type of steel investigated showed an increase with decreasing temperature, while the other cast steel displayed an opposite behavior. The modulus of elasticity was found to be practically the same in both cases and independent of the temperature.

Making Pipes

Manufacture of Sand-Spun Pipes, by J. B. Allen, *Foundry Trade Journal*, May 19, 1932.

Until last year vertically cast pipes held undisputed sway throughout the Stabeley Works. In 1929 construction was started on a plant to manufacture cast iron pipes in sizes from 2 to 12 inches in sand molds by the centrifugal process under license of the Sand-Spun Corp. of America. The first pipe was cast on June 3, 1931. The author has described in detail the equipment and the practice followed in the manufacture of sand-spun pipes at the plant of the English company.

Study Practice

Metallography and the Foundry (Metallographie et Fonderie), by Albert Portevin, *Bulletin* of the Association Technique de Fonderie, Paris, France, January, 1932.

As an introduction to the scientific study of foundry practice, Portevin points out that while the scientific investigator limits his investigation to small quantities of metal studied under special conditions, the founder must take into account necessities imposed on the casting for practical purposes. Various characteristics which apply in the manufacture of castings are defined and include capacity of a metal to fill a mold, contraction, major segregations, piping, blowholes and cracks. It is not always easy to differentiate between some of these defects, nor is there any means to value their importance. Study of the foundry gravitates around thermal conditions of castings and factors relating to cooling.

Cleaning Castings

The Cleaning of Castings (Le Dessablage des Pieces de Fonderie), by E. Tourneur. *La Revue de Fonderie Moderne*, Paris, May 10 and 25, 1932.

Two articles give a complete description of principles, processes, machinery and equipment used for cleaning castings. They cover use of abrasive wheels, pneumatic tools, sandblasting equipment, trummels, and cleaning by water under pressure. The articles indicate the air pressure to be used in pneumatic equipment, and the precautions to be taken with regard to the use of air compressors. The second instalment also deals with acid pickling, and cleaning by a combination of the sandblasting process and water under pressure.

Malleable-Iron

Investigations on the Manufacture of Malleable Hard Iron in the Brackelsburg Furnace through the Application of HK Special Pig iron (Versuche ueber Herstellung von Temperohguss im Brackelsbergofen unter Verwendung von HK-Sondsroheisen), by M. Paschke and K. Lange, *Die Giesserei*, Duesseldorf, Germany, Jan. 22, 1932.

Special pig iron mentioned by Paschke and Lange is one containing around 5 per cent total carbon; 0.015 to 0.020 per cent aluminum; 0.28 to 0.42 per cent silicon; 0.45 per cent manganese; 0.13 per cent phosphorus, and 0.01 per cent sulphur. Varying additions of the special pig ranging from 5 to 35 per cent were made to the charges which were melted in a rotating, powdered coal-fired furnace. Illustrations and diagrams show the special pig iron reduced shrinkage, and increase tensile strength, elongation, and yield point of the final iron.

High Test Cast Iron

(*Continued from page 27*)

tures with 5 per cent steel will result in 0.15 to 0.25 per cent lower total carbon product than when using the intermittent tapping process.

It is estimated that about 130 American foundries make an intermediate iron from charges containing about 50 to 60 per cent steel, with a tensile strength of 38,000 to 50,000 pounds per square inch. It is likewise estimated that about 30 foundries use a mixture for high test iron with over 80 per cent steel, with test bars breaking over 50,000 pounds per square inch.

It might be of interest to give the details of one example of producing the high steel charge metal which has been in successful operation for over four years. The cupola is 54 inches in diameter measured inside of lining with six tuyeres in one row. The tuyeres are 19 inches long x 5 inches high and are equally spaced around the cupola with the lower edge 19 inches above the sand bottom.

The by-product coke used contains ash, 8, sulphur, 0.7 per cent. Twenty-three hundred pounds of this coke is used on the bed, most of which is charged on the wood. After burning through, the remainder of the coke is added and the bed leveled. In charging, the pig iron and scrap are put in first, the steel then is added and the ferrosilicon thrown on top of the charge. After filling the cupola it is allowed to stand one hour before the blast is put on.

Blast Pressure Is Low

The metal charges are 3000 pounds in weight with 375 pounds of coke between charges. The charge consists of from 4 to 5 per cent of 50 per cent ferrosilicon, ½ of 1 per cent of ferromanganese, 6 to 10 per cent return high test iron scrap, 5 per cent pig iron, with remainder steel. The steel is 2/3 railway car springs and 1/3 steel rails cut to 2-foot lengths. A blast of 3600 to 3800 feet of air per minute is used, with a pressure of from 4 to 5 ounces. As a low carbon is desired, short taps are made and the cupola is kept fairly empty. It would be possible to reduce the total carbon in the iron by using less coke, but in view of the importance of having hot iron we have preferred to use the coke as stated.

To each 1000 pounds of metal going through the spout, 3 pounds of powdered ferromanganese - silicon (silicon 50 per cent, manganese 25 per cent) is added. When large castings are to be made with much machine work either 1 per cent nickel or 0.35 per cent molybdenum is added. Castings made from this iron include frames, tie pieces, hydraulic casings, gears, drums, dies, etc.

The iron so made has a short freezing range and must be handled quickly. In practice, it does not show a high internal shrinkage or porosity. It must be poured hot and fast and sand may burn on to the casting to some extent unless the sand is of a good quality. Dry sand molds are to be preferred and large risers should be used where possible. This iron is considerably harder than the usual run of cast iron and in fact machines about like a steel casting. The structure is pearlitic with small graphite flakes. Of course, foundry troubles are possible when using this iron, but none that cannot be overcome.

The accompanying table shows results covering a month's run—15 consecutive routine tests, all with nickel additions being reported. In this table representative tests of several ladles using molybdenum are listed and also of several heats using no alloys. These results are not in any way research or experimental, but were all made on ladles of iron used to produce commercial castings. On 200 consecutive routine tests made in 1929-30 the average tensile strength shown by the test specimens was 55,900 pounds.

All bars used were standard arbitration bars 1¼-inch in diameter and broken transversely between 12-inch supports. The tensile test pieces, Fig. 4, page 50 of THE FOUNDRY, for July, were cut from the broken halves of these bars.

To compare our own tensile bar with one more nearly like the British standard bar, the following tests were made. Six arbitration bars were taken at random and broken transversely as usual. From the broken ends of each bar two tensile specimens were machined, one into a regular tensile bar, and the other into a tensile bar 0.750-inch in diameter for a clear space of 2 inches between the bottoms of fillets. The results from the latter type bar are those marked with the (*) shown in the table. The results from our own bar are those given in the upper half of the same bracket. As the agreement between the two types of test bars was good, the remainder of the tests were made on our own bar.

Strength Is Unchanged

A variation in silicon of from 2.0 per cent to 2.75 per cent does not materially affect the strength. However, a high silicon, does tend to slightly soften the casting. If additional hardness or resistance to wear is desired, powdered ferro-chromium may be added in the spout. Higher strength values are obtained by using a higher percentage of alloys. However, the cost is increased with the higher percentage of alloys and there is a limit beyond which it is not commercially practical to go. We have not gone into the heat treatment of this iron as the size of our

Physical Tests From Standard Arbitration Test Bars

Iron Melted in 54-inch Cupola

Size Ladle lbs.	Trans Load lbs.	Def. inch	T S in Sq. In. in lbs.	Brinell Hardness	T.C.	Si	Sul.	Mn	Ni	Cr	Mo
7000	5780	0.16	(58,700 (57,900‡	285	2.73	1.88	0.079	0.63	1.12	*	†
2000	5730	0.14	73,700	285	2.64	2.14	0.080	0.69	1.12	*	†
7000	5560	0.14	66,500	297	2.50	2.16	0.078	0.74	1.00	*	†
7000	5600	0.15	59,000	277	2.97	1.88	0.087	0.62	1.37	*	†
7000	5800	0.16	(62,900 (64,700‡	285	2.87	2.05	0.091	0.64	1.20	*	†
2000	6270	0.17	64,900	293	2.50	2.66	0.103	0.72	1.29	*	†
7000	5850	0.17	(60,606 (60,250‡	285	2.79	2.00	0.088	0.61	0.88	*	†
7000	5630	0.15	(55,000 (54,800‡	293	2.61	2.25	0.081	0.68	1.29	*	†
9000	5740	0.15	55,000	277	2.81	2.07	0.093	0.67	1.15	*	†
2000	6020	0.19	65,500	285	2.91	1.97	0.087	0.71	0.97	*	†
9000	5810	0.16	(62,600 (62,300‡	277	2.82	2.16	0.080	0.68	1.20	*	†
9000	5390	0.18	54,500	262	3.05	2.37	0.096	0.70	1.01	*	†
6500	5960	0.19	61,200	262	2.79	2.34	0.087	0.75	0.98	*	†
25,000	5220	0.16	(51,800 (52,650‡	262	2.73	1.93	0.091	0.62	1.03	*	†
5000	5330	0.15	59,300	252	3.11	1.81	0.090	0.67	0.88	*	†
2000	5480	0.18	70,200	277	2.64	2.16	0.084	0.73	†	*	.34
2000	6240	0.18	67,100	277	2.51	2.82	0.089	0.74	†	*	.28
2000	6470	0.19	62,300	262	2.74	2.41	0.072	0.74	†	*	.29
Iron Melted in 72" Cupola (No alloys)											
20,000	4960	0.15	55,500	265	2.59	1.88	0.089	0.80	*	*	†
44,000	5160	0.14	51,400	255	2.94	2.65	0.100	0.77	*	*	†
20,000	5170	0.16	61,900	285	2.60	2.07	0.100	0.70	0.19	*	†
40,000	4850	0.15	57,100	262	2.49	2.07	0.081	0.68	0.18	*	†
30,000	5150	0.14	60,000	269	2.69	2.45	0.086	0.83	*	*	†

‡Tensile strength results obtained from test of design shown in Fig. 6. *Trace. †None.

castings is such as to make this inadvisable.

Castings have been made which weighed 114,000 pounds in the rough and there is no reason to believe there need be any particular limit in size. Two cupolas 72 inches diameter were used to melt the iron for these castings. Some time ago a 25-ton casting was made and broken up for test purposes. Arbitration tests bars cast from the ladle iron broke at 50,500 pounds. Tensile bars machined from a rib 2½ inches in thickness broke at 42,000 pounds and tensile bars hollow drilled from center of a 6-inch section in middle of casting broke at 30,000 pounds per square inch. The grain was fine and close throughout. No shrinkage or spongy spots were found where light and heavy sections came together. The analysis of this metal gave:

	Per cent
Total carbon	2.73
Silicon	2.36
Sulphur	.09
Phosphorus	.98
Manganese	.73
Chromium	.....
Nickel	.....
Molybdenum	.....

Physical Properties

This higher test iron shows less loss of strength in heavy sections than the other irons lower in tensile strength; also, the structure is more nearly uniform throughout, although the grain becomes somewhat more open as the center is approached. The hardness of a 4-inch section was practically uniform, as reported in a paper by the present writer, delivered before the American Society for Testing Materials, in 1929.

Elongation is low, only 0.5 per cent being observed in untreated bar.

A non-alloy, high-test, cupola iron with a tensile strength of 50,300 pounds per square inch was tested in fatigue, using the "RR" Moore machine. The endurance limit found was 24,100 pounds per square inch. These tests were described in a paper before the American Society for Testing Materials, in 1928, by J. B. Kommers.

An effort was made to determine the effect of a long time hold at high temperature, and the apparatus was described in a paper by R. S. MacPherran and R. Krueger at an A. F. A. meeting in 1930. It was hoped that the low carbon and fine grain would maintain its hardness and strength. This did not prove to be true, although the specimen containing chromium held up better than the others. Most of the action took place in the first 500 hours. Specimens were held at 1100 degrees Fahr. for 8000 hours, the test being interrupted at long intervals to determine loss of strength and hardness.

This iron shows a much higher impact value than the lower tensile strength irons. We have as yet, however, no standard methods of comparison, as noted by H. Bornstein in an A. S. T. M. paper in 1929.

There are many references in published literature to increase resistance to wear in using this iron, but the writer has seen no reliable data. This is a subject on which there is a great need of research.

In the opinion of the writer, we have seen only the beginning of the development of cast iron. Heat treatment and alloys will do as much for cast iron as they have done for cast steel.

Obituary

COL. E. H. WILLIAMS, president and general manager, Vulcan Iron & Mold Co., Latrobe, Pa., was fatally injured in an automobile accident near Latrobe on July 7. From 1892 when he was graduated from the Case School of Applied Science, Cleveland, with a degree of bachelor of science in mining engineering, Col. Williams has been connected actively with the iron and steel industry. Immediately after graduation he became chief chemist and metallurgist, Brown Bonnell Iron Co., Youngstown, O., remaining with that organization until 1896 when he was made assistant superintendent, blast furnace department, Illinois Steel Co., Joliet, Ill. From 1899 to 1906 he was manager of blast furnaces, Pickands, Mather & Co., Sharon, Pa., and Toledo, O., and in the latter year was made vice president and general manager, Perry Iron Co., Erie, Pa. In 1913 he became manager of bast furnaces, Thomas Iron Co., Easton, Pa., and remained there until 1916 when he was commissioned a major, engineers corps, United States army. Later he was made lieutenant colonel and then colonel and was a member of the general staff in charge of officer personnel. Following the war he became manager of service and inspection departments, Valley Mould & Iron Corp., Sharpsville, Pa., and in 1923 became president of the Vulcan Mold & Iron Co., Latrobe, Pa.

John Rourke, 90, a veteran foundryman, died at his home in Savannah, Ga., recently.

John Voogd, Foundry Superintendent, Buss Machine Works, Holland, Mich., was killed in an automobile accident recently.

Charles J. Cooper, 89, who was vice president of the former H. W. Cooper Hardware Saddlery Co., Moline, Ill., now part of the Moline Iron Works, died at Nantucket, Mass., June 19.

Emerson M. Williams, 34 for the past five years secretary-treasurer of the Standard Alloy Co., Cleveland, died at Cleveland July 16. He was a graduate of the University of Michigan.

J. Fred Arundell, 77, a retired manufacturer of architectural cast iron, died recently in Riverdale, N. Y. He was a native of England and came to the United States in 1875. He retired in 1912.

Roy C. Blanchard, 40, production engineer, grinding machine division, Norton Co., Worcester, Mass., died June 29. Mr. Blanchard was a graduate of Worcester Polytechnic Institute and has been connected with the Norton Co. for 16 years.

Charles B. Erhart, 62, former president of the Chris Erhart Foundry & Machine Co., Cincinnati, died recently. He succeeded his father in the business, and retired two years ago. One son, Charles C., now is president and treasurer of the company, and another, Thomas H., is vice president and secretary.

James Hughes, pioneer Wisconsin foundry owner, died July 22 at the age of 75. He established the Eagle Iron & Brass Foundry at Fort Howard, now Green Bay, Wis., in 1879. Later he became general superintendent of the Giddings & Lewis Mfg. Co., Fond du Lac, Wis., retiring from active business in 1921. He was a native of Brookfield, Wis., and served his foundry apprenticeship in Milwaukee.

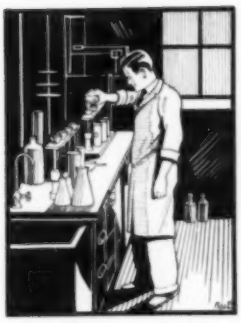
Dr. George K. Burgess, for the past nine years director of the bureau of standards, Washington, and associated with the bureau since 1903, died unexpectedly at Washington, July 2. Born in Newton, Mass., Jan. 4, 1875. Doctor Burgess was graduated from Massachusetts Institute of Technology in 1896. Five years later he was made a doctor of science by the University of Paris. In 1903, he began with the bureau of standards as associate physicist and advanced to director in 1923. Among his contributions to science are noteworthy tests and specifications of rail and car wheels, a process for rustproofing steel and research on the properties of gases in steel.

Standards Published

The 1932 edition of the *Standards Yearbook* has been issued by the National Bureau of Standard as miscellaneous publications No. 133, and may be purchased from the superintendent of documents, government printing office, Washington, for $1, or through the office of the American Standards association.

The standing committee of the industry in charge of simplified practice No. 48, entitled shovels, spades and scoops has reaffirmed the existing schedule without change, according to announcement by the division of simplified practice of the bureau of standards, Washington.

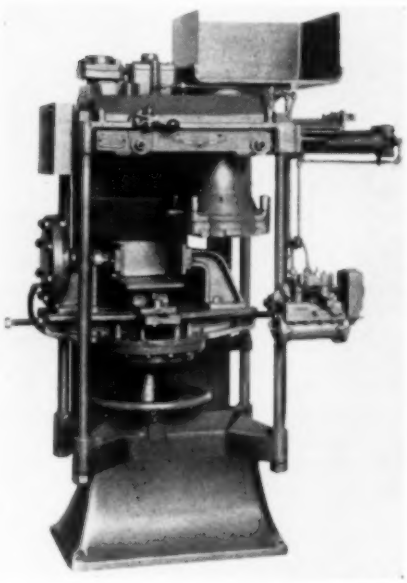
New Equipment



For Foundries

Develops New Core Blowing Machine

Osborn Mfg. Co., 5401 Hamilton avenue, Cleveland, has introduced a core blowing machine designed to produce cores of uniform porosity and density at high speed. As shown in the accompanying illustration, the machine



An automatic valve controls all operations in sequence

consists of a rugged base which supports the clamp table and clamp. Four vertical rods attached to the four corners of the base in turn support the sand bin and chamber, blow plate, valve and operating mechanism.

A 3-inch diameter adjustment screw, equipped with a hand wheel, is provided to raise and lower the clamp table. A guide on one of the rear rods holds the clamp table securely when in operation and prevents side motion when using a special sealing attachment for the front of certain types of core boxes. An adjustable clamp of the diaphram type, and a substantial stop arm, hold the core box in position during the blowing operation. All of the adjustments may be made with one wrench.

A large sand chamber is constructed to permit an even flow of sand. The sand chamber supports a dovetail-type, quick-change, blow plate, which requires no bolts. A safety valve, located in the top portion of the machine, must be actuated by the left hand of the operator while the right hand is moving the master valve. This prevents possible injury to the operator's hands while the sand chamber is moving into the blowing position. A second safety device is included to prevent the machine blowing unless the core box is in position to receive the sand.

A feature of the design is the automatic valve which controls all operations in sequence following the movement of the lever by the operator, and provides a definite time allowance for each operation. In operating the machine, the operator places the core box in the machine. He then pushes the safety lever with the left hand and moves the valve lever with the right. After the valve starts to function, it will perform a complete cycle of operations without further attention, and the operator is free to take the core previously made from the box. The valve causes the clamp to close, the sand chamber to move over the box, the sand to be blown into the box, the sand chamber to return to the side of the machine and the clamp to release the box.

Designs Flux for Welding Chromium Alloys

Linde Air Products Co., 30 East Forty-second street, New York, has developed a new flux for use especially in welding chromium containing alloys, known commercially as stainless steel or rustless iron. It is pointed out that the flux for use in welding these alloys must be sufficiently fireproof to protect the molten metal and hot metal adjacent to the weld from oxidation, and at the same time, must be correctly compounded to dissolve the refactory chromium oxide. The new flux, it is claimed, has a solvent power for chromium oxide and a high resistance to heat.

H. S. Woodruff has been appointed engineer in charge of design of the newly formed air conditioning department, General Electric Co., Schenectady, N. Y.

Lifts Loads on Tapered Steel Fingers

A new lifting and tiering truck that will pick up cleated loads with 2 inches under-clearance has been developed by the Clark Tructractor Co., Battle Creek, Mich. The load is carried on tapered steel fingers with a standard length of 26 inches, which touch the floor in the down position. Fingers tilt back slightly in the first

The unit will pick up cleated loads with 2-inch under clearance

5 inches of rise to give balance for the load.

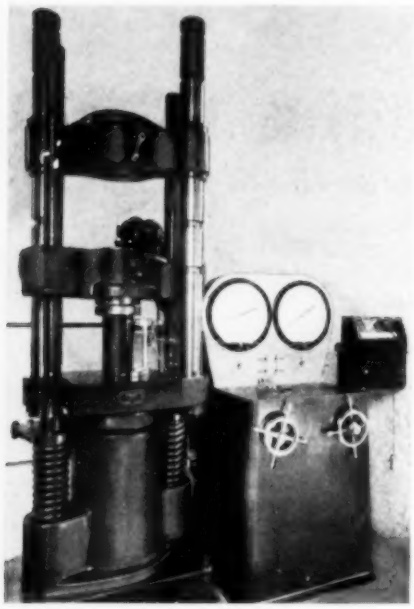
Flexibility is secured by four wheel steer and rear wheel drive. The 2-ton model has a turning radius of 89 inches, the 3-ton a turning radius of 96 inches. The unit is driven by a gasoline engine. Maximum lifting and carrying capacity is supplied by a hydraulic lift mounted over extra large rubber tires.

Centrifugal Pumps To Handle Chemicals

Hills-McCanna Co., 2349-59 Nelson street, Chicago, has developed a new line of ball bearing centrifugal pumps for handling chemicals and other liquids. Shaft and impeller alignment is accomplished by providing ball bearings to carry the load in any direction. The stuffing box is of split screw gland type, which it is pointed out, always will pull square, permits proper seal with the minimum pressure and can be packed easily.

Introduces New Stress Strain Recorder

Baldwin-Southwark Corp., Southwark division, Philadelphia, recently introduced a stress-strain recorder which is serviceable with all makes of machines employing hydraulic pressures for load measurements. Relatively minor modifications in construction makes its accuracy and convenience available to users of other types of testing machines such as pendula or poise-and-lever. The instrument is shown in the accompanying illustration.



Recorder is suitable for research work and routine testing

Principle of operation is based on that found in the most accurate of recording instruments; namely the use of an outside source of power (a small motor in this case) to operate the moving parts, motion being controlled by the values to be measured.

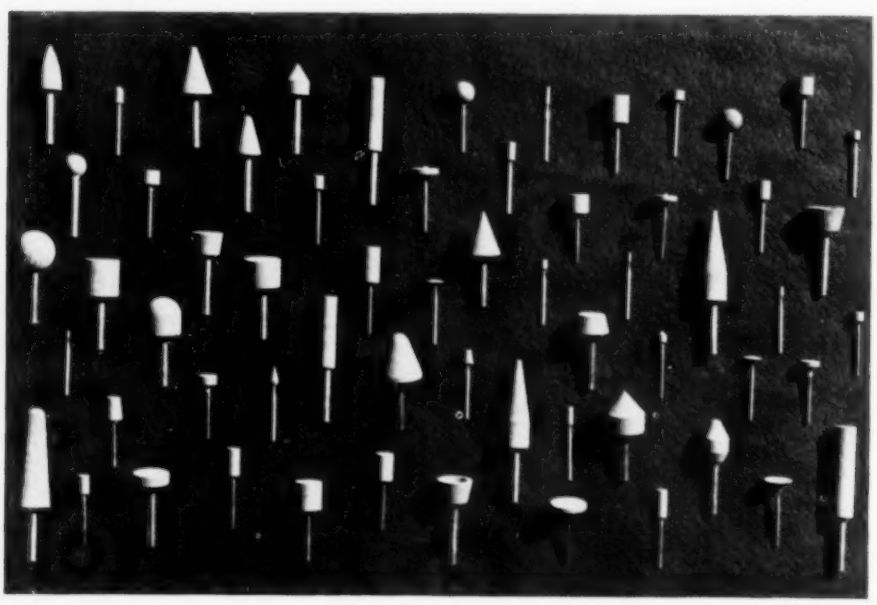
It is pointed out the stress strain recorder is suitable for research work because of the high degree of precision of the diagrams obtained. It is suitable for routine testing because it is virtually fool-proof and automatic in operation. Extensometer and loading element control the pencil and drum motions. Sensitivity of the unit is such that 0.00001-inch strain in a specimen produces a readable motion of the recording pencil.

Grinding Tools Made in Many Shapes

Norton Co., Worcester, Mass., has developed a special line of machine shop tools, such as wheels, points, pencils, buttons and other shapes including more than 100 different shapes. These range from tiny points 3/32-inch diameter to wheels 1-inch in diameter.

Most of these mounted abrasive products are made of a special grade of aluminum oxide which was developed expressly for tool and die work. That abrasive has a particular crystalline structure which gives it a temper different from the regular aluminum oxide abrasive, producing a singular grinding action. For production grinding of small holes most of the mounted wheels and points are made of regular aluminum oxide abrasive and for nonferrous and nonmetallic fields there are silicon carbide abrasive points and wheels.

The spindle on all the products is made of a special steel which is first coppered and then nickel plated. It is knurled and designed with a chisel end to insure permanent anchoring of the abrasive on the quill. A special cement of high strength is used. Generally speaking these points and wheels are made with vitreous bonds, bakelite-bonded points or wheels are made for specific purposes. A number of different shapes developed are shown in illustration.



Over 100 different shapes are provided, ranging from 3 32 to 1 inch in diameter

Sealing Solution For Porous Castings

Bakelite Corp., 247 Park avenue, New York, recently has introduced a sealing solution representing a new process for reclaiming sweating or leaking casting, which it is claimed insures the production of cast parts, the equivalent of castings that pass the most exacting inspection and test. The sealing solution has several important characteristics. After proper treatment, it will not melt or dissolve in solution. It is also pointed out that the material is unaffected by hot or cold water, steam or temperatures up to 400 degrees Fahr.

The manufacturers point out that the sealing solution cannot be relied upon to seal castings containing blow-holes, sand-holes or other decided defects. However, it is suited for porous castings, spongy spots or sweating leaks in pressure castings. In operation, castings are cleaned to insure freedom from grease and dirt, and are plugged or otherwise set up so that it may be filled with the sealing solution. Air-pressure of 250 pounds per square inch is introduced on top of the solution to force it into the pores of the casting. If pressures that high cannot be used, lower pressures may be applied, but it has been found that 250 pounds pressure is the most desirable where exceedingly fine porosity exists. The casting is subjected to the treatment for a maximum of 30 minutes, although from 2 to 5 minutes usually is sufficient. The pressure then is relieved, the solution drained from the casting. The treated part is then placed in an oven and baked for 1 to 2 hours at 275-300 degrees Fahr., the exact time and temperature depending upon the weight of the casting, and the type of oven used. It is pointed out that it is not harmful to overbake the solution since it reacts chemically under heat to become completely insoluble and infusible.

Meet in Chicago

Tenth annual convention and show of the oil burner industry will be held in Chicago at the Hotel Stevens during the week of June 11, 1933, in conjunction with the opening of the "Century of Progress."

Lindrooth, Shubart & Co., Boston building, Denver, Colo., have been appointed representative of the Magnetic Mfg. Co., Milwaukee, in the Denver territory.

Melts Steel in High Frequency Furnace

A four ton coreless induction furnace capable of melting 40 to 50 tons per day, was placed in operation in the Chicago district during the fall of 1931. The furnace, almost double the size of any coreless melting unit previously installed, is used mainly to melt low carbon stainless steel scrap, also ferroalloys for addition to larger furnaces, metal for special steels and other alloys.

The coreless induction furnace is essentially an air transformer whose primary is a single layer helix of water cooled copper tubing and whose secondary within the coil is the conducting mass, which in the furnace described constitutes the charge to be melted. Induced currents circulate in the outer part of the charge, and thereby heat it. The charge is stirred as much or as little as desired by electrical forces within the bath. It is claimed that melting can be accomplished rapidly and with little wear on the furnace lining. The temperature of the metal in the bath can be controlled closely by regulating the power input.

The furnace, titled for pouring, is shown in the accompanying illustration. The construction differs from previous furnaces of that type in that the coil and hearth, with space around them, are supported on structural steel beams attached to the sides of the case near the bottom. Molten metal which may accidentally leak should fall into a pit below the furnace thus reducing the danger of serious injury to the furnace casing. A spare furnace, now being installed, will prove complete continuity of operation.

The furnace case is made of structural steel shielded inside with sheet copper. The four ton furnace operates with a temperature rise in the housing of only a few degrees and then only where it comes nearest to the coil. The lining is rammed about an asbestos shell and a refractory, consisting of a mixture of magnesia and alumina of suitable grain sizes, is used. Lining life is reported as satisfactory while melting 18-8 and other high chromium alloys.

The electrical connections are broken when the furnace is titled. Water connections can be disconnected for about one-half hour without boiling the water out of the coil. The furnace is titled for pouring about an axis in line with the spout. The 1000 cycle motor generator set is cooled with washed air provided by a washer supplied by the General Electric Co., and installed in the room below the set. The bearings are provided with oil under pressure. The set runs at 1500 revolutions per minute.

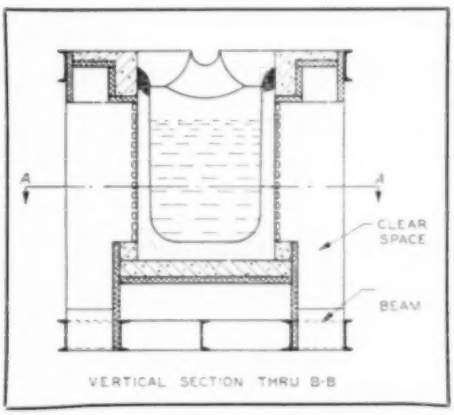


Fig. 1.—Vertical section through the coreless induction furnace

Design Air Line Valve for Quick Action

Murdock Mfg. & Supply Co., 426-430 Plum street, Cincinnati, has introduced a new air valve which may be opened and closed quickly. A cam action, used in automobile engines, is the mechanical principle employed in the new air valve, thus eliminating friction at the seat and regrinding. The valve cannot be left partly open since a spring closes it the instant the cam is turned past the center. This spring also holds the valve closed under pressure to prevent leaks. As soon as the valve rests on the seat, the cam is disengaged, preventing the valve being forced or jammed at the seat.

The disk is standard and renewable and the gland or stuffing box can be repacked without taking the valve from the line or shutting off the air. The valve is made entirely of red brass, with the exception of a hard bronze cam shaft and a steel handle. It is made in sizes ranging from ½-inch to 2 inches.

Flux Coats Welding Electrodes

Metal & Thermit Corp., 120 Broadway, New York, acting as exclusive sales agents for the American Murex Corp., has placed upon the market a new line of arc welding electrodes containing a heavy, all mineral flux coating. The electrodes are 18 inches long and are of various types and sizes for horizontal, vertical and overhead welding operations for mild steel, manganese steel, 18-8 stainless steel and stainless iron. The electrodes contain a spiral winding of asbestos yarn which is impregnated with the mineral flux under pressure.

Martin H. Kidder, formerly connected with the publicity department, Link-Belt Co., Chicago, has opened a press service with headquarters at 12238 Normal avenue, Chicago.

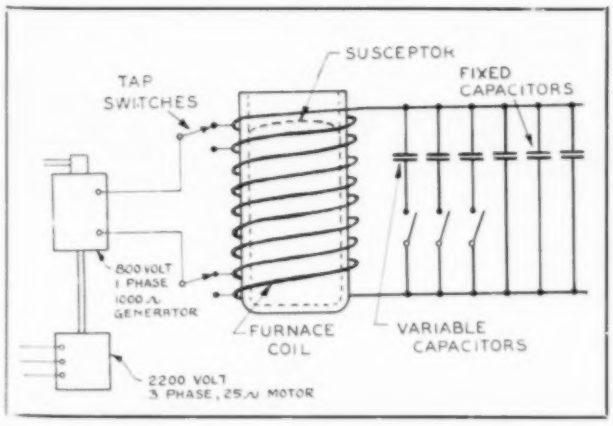
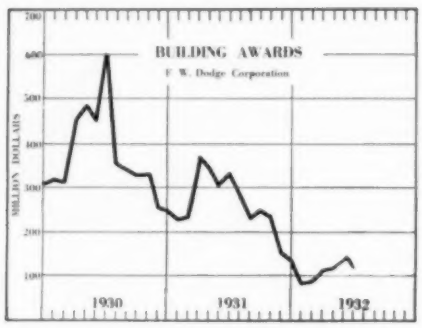
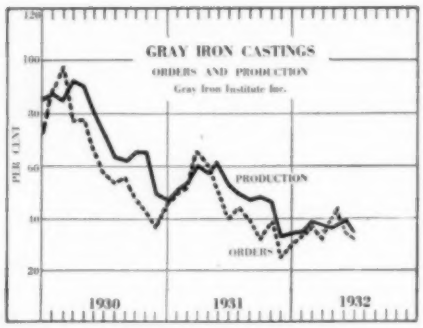
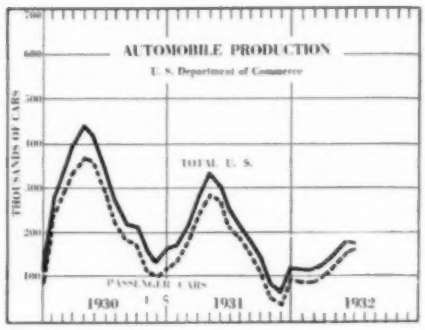


Fig. 2 (Below)—Simplified circuit diagram. Fig. 3 (Right) — Four-ton coreless induction furnace in pouring position







Foundry Activities

Reflect Industrial Trends

AKRON SUPER STEEL CASTINGS, INC., has leased the steel foundry plant of the Adamson Machine Co., 740 Carroll street, Akron, O., and announced starting operations Aug. 10.

C. F. Adamson, president of the Adamson Machine Co., Akron and Adamson Mfg. Co., East Palestine, is president of the new concern; Norman E. Daub, former general sales manager, Atlantic Foundry Co., Akron, is vice president, and C. B. Mitchella, general manager of the Adamson Machine Co., is secretary-treasurer.

Fred Hays and Harry Orr, formerly with the Atlantic Foundry Co., will be in charge of manufacture.

* * *

Petition for the liquidation of the Elmwood Casting Co., Cincinnati, has been filed in Common Pleas court.

* * *

Lamar Street Foundry & Pattern Works has been established at 900 South Austin street, Dallas, Tex.

* * *

Valley Mold & Iron Corp, Sharpsville, Pa., recently resumed operations after being idle for several months.

* * *

Newcomerstown, O. plant of James B. Clow & Sons has resumed operations on a six day a week basis.

* * *

Chickasaw Brass Works, 260 North Front street, Memphis, Tenn., recently resumed operation.

* * *

Universal Foundry Co., Oshkosh, Wis., has added equipment for production of brass and bronze commercial castings. Output formerly was confined to gray iron, alloys and aluminum castings. The new line will include castings up to 250 pounds, in gray iron, brass, bronze and aluminum.

* * *

Hay Foundry & Iron Works of McClintic-Marshall Corp., 72 Roanoke avenue, Newark, N. J., recently was damaged by fire.

* * *

Foundry, sawmill and garage owned by Eugene Galarneau, Pont Rouge, Que., recently were practically destroyed by fire.

* * *

Syracuse Chilled Plow Co., 111 Wyoming street, Syracuse, N. Y., a subsidiary of Deere & Co, Moline, Ill, resumed operations recently on a schedule of 3 days a week, after being closed since early April.

* * *

Fishbach Foundry & Engineering Corp., Pottsville, Pa., has been incorporated with $25,000 capital to operate a foundry and machine shop, by Edna C. Oakley, 622 North Centre street, Pottsville.

* * *

C. G. Foundry Co., 1026 Kentucky avenue, Indianapolis, will build a 1-story foundry, 160 x 160 feet at Twenty-fifth and Yandes streets, to cost $40,000. Contract has been awarded.

* * *

A. Gilbert & Sons Brass Foundry, 4015 Forrest Park boulevard, St. Louis, has been taken over by the Gilbert Brass Foundry, recently organized by Charles F. Gilbert.

* * *

F. Holtz Co., 18 Third avenue, Evansville, Ind., has been reorganized. Directors are as follows: Ferdinand Holtz, Henry Holtz, Carl F. Helming, Fred Bernhardt, C. Eugene Johnson and John Reuter.

* * *

Hobart Mfg. Co., Troy, O., manufacturer of electric food preparing machines, has bought the physical assets of the Star Foundry Co., Troy. The latter will continue its corporate identity until it can close up its business.

* * *

Worthington Pump & Machinery Corp., with executive offices at 2 Park avenue, New York, and general offices at Harrison, N. J., will transfer and consolidate its designing, engineering and manufacturing activi-

RAW MATERIAL PRICES
Aug. 8, 1932

Iron	
No. 2 foundry, Valley	$14.50
No. 2 Southern, Birmingham	11.00
No. 2 foundry, Chicago	15.50
No. 2 foundry, Buffalo	16.00
Basic, Valley	14.00
Basic, Buffalo	15.50 to 16.00
Malleable, Chicago	15.50
Malleable, Buffalo	16.50
Coke	
Connellsville beehive coke	$3.00 to 4.25
Wise county beehive coke	4.25 to 5.00
Detroit by-product coke	8.00
Scrap	
Heavy melting steel, Valley	$8.00 to 8.50
Heavy melting steel, Pitts.	8.00 to 8.50
Heavy melting steel, Chicago	5.00 to 5.50
Stove plate, Buffalo	6.75 to 7.00
Stove plate, Chicago	5.00 to 5.50
No. 1 cast, New York	5.00 to 5.50
No. 1 cast, Chicago	5.50 to 6.00
No. 1 cast, Philadelphia	9.00
No. 1 cast, Pittsburgh	8.50 to 9.00
No. 1 cast, Birmingham	6.50 to 7.00
Car wheels, iron, Pittsburgh	8.50 to 9.00
Car wheels, iron, Chicago	6.00 to 6.50
Railroad malleable, Chicago	5.00 to 5.50
Agricultural mal., Chicago	5.00 to 5.50
Malleable, Buffalo	8.00 to 8.50
Nonferrous Metals	
	Cents per pound
Casting copper, refinery	5.12½ to 5.25
Straits tin	22.45 to 22.50
Aluminum, No. 12, producers	22.00
Aluminum, No. 12 remelt	7.00 to 8.00
Lead, New York	3.10
Antimony, New York	5.00
Nickel, electro	35.00
Zinc, East St. Louis, Ill.	2.75

ties formerly carried on at its Cincinnati works with those at Buffalo. Cincinnati plant equipment will remain intact for the present and the Cincinnati district sales office will not be affected, Earl Vinnedge remaining in charge.

* * *

Tolhurst Machine Works Inc., a subsidiary, American Machine & Metals Inc., New York, P. B. Muniford president has purchased Sweet & Doyle Foundry & Machine Co., Green Island, Troy, N. Y. Tolhurst Machine Works Inc. and Sweet & Doyle Foundry & Machine Co. will be under the supervision of Perry Holder, manager and vice president of the Tolhurst company. Alexander F. Zak will be in charge of operations. The companies will be located at Green Island.

* * *

Acme Foundry Co., Thirtieth avenue and Northern Pacific Railway, Minneapolis, recently purchased the business and plant of Progressive Metal Products Inc., 3161 Hiawatha avenue, Minneapolis. Additional equipment is being purchased, a fireproof vault for patterns is being constructed and operations of the Acme Foundry gradually are being moved to the new location so that by Nov. 1, all activities will be centered at the Progressive plant. H. J. Bierman and M. A. Palbicki are owners of the Acme company

* * *

The Union Iron Works Co., Washington, is in the market for 120 tons of gray iron castings approximating in size ⅝ x 23 x 82 inches. These castings are made for a contract at the library of congress. J. H. Ford is president.

* * *

Nolte Brass Foundry Co., Springfield, O., recently acquired the equipment of the Thompson-Owens Corp., Toledo, O., according to Allan A. Nolte, secretary-treasurer and general manager of the company. The Thompson-Owens Corp., specialized in finished bronze bushings in sizes ranging from a fraction of an inch to 18 inches in diameter. Acquisition of the modern machinery of the Thompson-Owens Corp., enables the Nolte company to add to its line of products. Arrangement of new equipment at the Nolte plant has been completed and operations are now under way.

George Thompson, formerly with the Thompson-Owens Corp., and associated for 40 years with the finished bronze bushing business, has been named superintendent of the finished bronze bushing department. The Nolte Foundry Co. was founded in 1886 and was incorporated Jan. 21, 1923. Officers are as follows: A. B. Nolte, president, W. H Pence vice president and Allan A. Nolte, secretary-treasurer and general manager.

New Trade Publications

JEFFREY MFG. CO., Columbus, O., recently published its catalog No. 50 illustrating and describing its line of foundry equipment. The first section presents a number of interesting illustrations showing mold, sand and other types of conveyors installed in several brass and steel foundries. A machine for filling flasks with sand then is described and interesting installations are illustrated. Other equipment shown includes continuous handling equipment, crushing and pulverizing equipment, sand mixers and conditioners, apron conveyors, sandblast nozzles, foundry stars, etc.

COMPRESSORS — Feather valve vertical two-stage air compressors are described in a recent bulletin of the Worthington Pump & Machinery Corp., Harrison, N. J. Information presented includes specifications, dimensions and a sectional drawings showing method of construction and operation.

X-RAY—Claud S. Gordon Co., Chicago, has published a folder discussing the application of the X-ray to the inspection of welds.

SWITCHES — Standard, general purpose magnetic switches are illustrated and described in a bulletin recently published by the General Electric Co., Schnectady, N. Y.

CUPOLA BLOCKS—A folder recently published by the Ironton Fire Brick Co., Ironton, O., gives information on the chemical and physical properties of its line of cupola blocks.

WELDING EQUIPMENT—Bastian-Blessing Co., Chicago, has published a catalog containing information on its line of welding equipment, including welding rods, electrodes, cast-iron welding rods, tobin bronze, fluxes, torches, generators, etc.

FANS—Bulletin No. 166 of the Duriron Co. Inc., Dayton, O., discusses exhaust fans for ventilating laboratory hoods, pickling rooms and other points where acid-resisting equipment is necessary. The bulletin is particularly well illustrated.

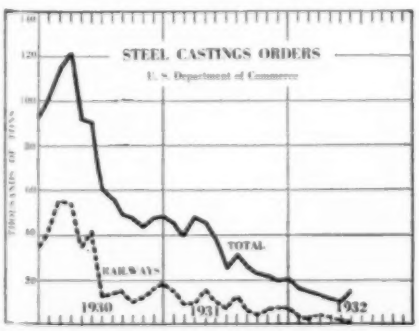
ELECTRIC MOTORS — Reliance Electric & Engineering Co., Ivanhoe road, Cleveland, has published its bulletin No. 111 describing squirrel-cage induction motors designed for general purposes. The bulletin includes photographs and information on methods of manufacture, construction and operation.

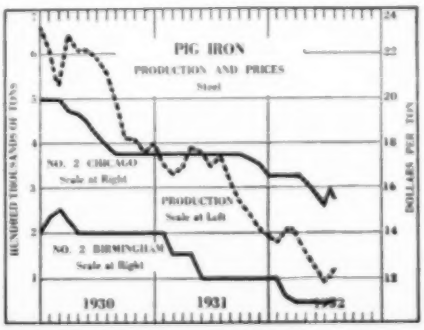
PROTECTIVE COATING — Smith Oil & Refining Co., Rockford, Ill., describes an oil for spraying and dipping exposed metal parts as a protection against rust and corrosion. It is pointed out that the material when applied with a spray gun, spreads evenly over all parts of the material being covered, and also that it may be removed swiftly and inexpensively by wiping the surfaces with a kerosene-dampened cloth.

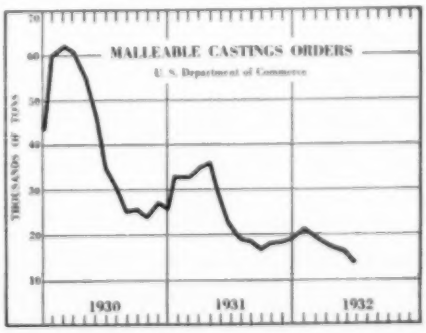
MOLYBDENUM—Climax Molybdenum Co., 295 Madison avenue, New York, has published a 52-page booklet discussing "Molybdenum in 1931." This book contains a reprint of the article "Molybdenum, Today and Tomorrow" by J. L. Gregg and H. W. Gillett. A selected bibliography of molybdenum, a discussion of molybdenum steel, and cast iron, and a collection of micrographs also are included. Considerable valuable technical data on the subject of molybdenum are presented.

Discover Ruins of 16th Century Foundry

RUINS of the old pontifical foundry, where cannon were cast for papal armies, have been found by excavators for the new Vatican postoffice, according to an Associated Press dispatch. The foundry was built under Pius IV, who was pope from 1559 to 1565. It fell out of use long ago. Metal statues, including that of Napoleon in the Palace Vendome at Paris, were cast in the papal foundry.







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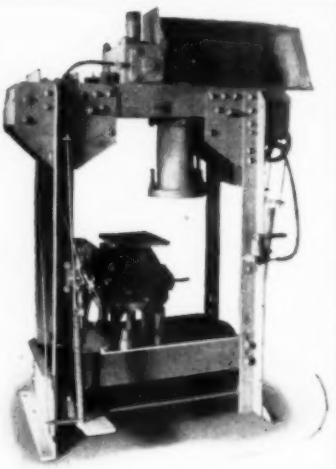

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